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V. 2-040506

SITE: Ore Knob
BREAK: 11.9
OTHER:

J. B.

SEP 14 1962

CLOYD M. SMITH
MINING ENGINEER

MUNSEY BUILDING
WASHINGTON 4, D. C.

September 13, 1962

TO	V	IN.
R.A.		
J.B.		
H.C.		
G.M.G.		
C.N.		
J.O'C.		
ACCTG.		
SALES		
FILES		

Mr. James Boyd, President
Copper Range Company
630 Fifth Avenue
New York 20, New York

Dear Mr. Boyd:

Pursuant to your acquisition of the Ore Knob copper property in North Carolina, it occurs to me that you might want to consider the Peach Bottom mine which is nearby. It is said to have been operated profitably for copper and silver 50 or 60 years ago. It has been in one family and the present heirs say that operations were stopped because of water, and never resumed.

One of the heirs of the estate, a professional engineer, informs me that he is authorized to lease or sell the property and has asked me to help him in its disposal. They prefer a conventional mining lease with royalty payments, etc., but will consider any reasonable proposal.

Unfortunately there are few data on the property at hand but I enclose two diagrams that indicate location, topography and basic geology. I believe there are some early day publications on the Peach Bottom and Ore Knob deposits that could be abstracted in a few days of library research if some interest develops with respect to Peach Bottom.

If you would like to investigate this please let me know. I can develop further information andor put you in touch with the representative of the owners whenever you like.

As an entirely separate matter I have an inquiry from a newly formed, heavily financed, Japanese consortium that is just starting into the business of scouring the free world for nonferrous mines and mineral deposits. They are particularly interested in copper in Latin America, Africa, Asia; porphyry type; open cuttable; developable to 10,000 tons of metallic copper per year.

Any suggestions?

Sincerely,

Cloyd Smith

hem
enc

similar to the Ore Knob deposit as an extension laterally and in either the hanging or foot walls to 2500N and 3500S and to a depth of some 1750 feet.

The IP results were examined in relationship to self potential data, geochemical results, magnetic patterns, and EM data. No attractive targets for further exploration could be recognized from this examination.

I suggest that you think about having the geophysists make calculations on the magnetic high that parallels the ore vein some 1500 feet to the south. I agree with you that this feature is too regional in character to be a direct expression of an ore vein, but it could be an expression of a feature related to the ore vein. For example, could the sulphide mineralization be associated with an intrusive, perhaps gabbroic in nature, that lies at depth. A test of this possibility through calculation of the magnetic anomaly and assumed magnetic susceptibility for gabbroic rocks may be an interesting exercise. True, it is academically inclined from the standpoint of additional ore at Ore Knob, but it may give a clue that is valuable if regional exploration in that geologic environment is contemplated for the future.

Excellent thought

Sulphide emplacement emanating from such an intrusive would be expected to migrate upward along the regional structural grain, i.e., the gneissosity in this case. Thus the intrusive would be expected to lie to the south of the ore vein itself. Furthermore, is it not logical to expect any structural deformation such an intrusive may impose would tend to align with the structural grain? The Ore Knob ore vein has this attitude.

ditto

And finally, if a gabbroic intrusive at depth, a depth that could be reasonably estimated from magnetic considerations and calculations, is a reasonable assumption, is it not equally reasonable to assume that intrusive body may be linked to the Ore Knob ore vein by sulphide emplacements in the structural pattern created locally?

ditto

Kindest regards.

Sincerely,

Jack

Jack A. James

Mr. Bryant
Mr. Geology

September 14, 1962

Mr. Cloyd H. Smith
Munsey Building
Washington 4, D. C.

Dear Mr. Smith:

Thank you for your letter of September 13 regarding the Peach Bottom mine.

I have sent this on to our Manager at Ore Knob to discuss with our Chief Geologist. At the moment we are exploring Ore Knob and this will command our full attention for several months. I will write you again as soon as we have evaluated our findings.

With best regards,

Sincerely,

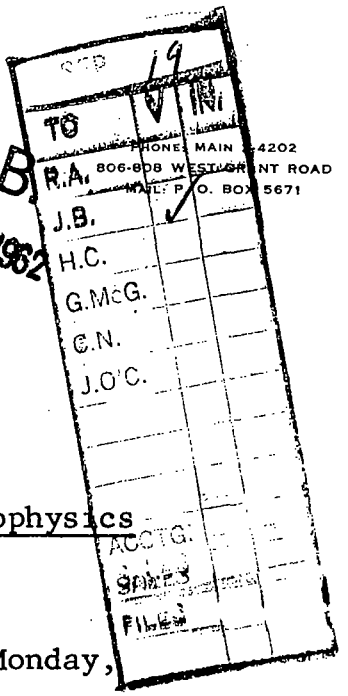
JB:ja

bc - Messrs. Philip Eckman
C. O. Ensign, Jr.

HEINRICHS GEOEXPLORATION COMPANY
MINERAL ENGINEERING CONSULTANTS AND CONTRACTORS
GEOPHYSICAL, GEOLOGICAL AND ECONOMIC APPRAISALS
TUCSON, ARIZONA

WALTER E. HEINRICHS, JR.
E. GROVER HEINRICHS

PHONE: MAIN 4-4202
R.A. 806-808 WESTWARD HOME ROAD
MAIL: P.O. BOX 5671



September 17, 1962

Dr. James Boyd, President
Copper Range Company
630 Fifth Avenue
New York 20, N. Y.

Re: North Carolina Geophysics

Dear Jim:

This will confirm your telephone call of Monday, September 10th.

I will be out of town the week of 17 September, attending the S. E. G. meeting in Calgary, Canada and the following week at Mining Congress in San Francisco. If necessary, I can be reached through my office here, or my brother Grover and the rest of the staff who will be holding the fort in my absence, can answer any questions requiring immediate attention.

Meanwhile, we will look forward to hearing from Mr. Chester Ensign and in assisting in any way that we can.

Best personal regards,

Sincerely,
Completed in absentia, original dictated or signed by

Walter E. Heinrichs, Jr.

WEH:jh

J. B.

SEP 20 1962

SEP 20		
TO	V	IN.
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ACCTG.		
SALES		
FILES		

September 18, 1962

Walter E. Heinrichs Jr., President - General Manager
Heinrichs Geoexploration
P.O. Box 5671
Tucson, Arizona

Dear Walter:

On Thursday, September 13th, I asked our resident geologist at Ore Knob, North Carolina, to send you the following:

(1) Property Map of the Ore Knob Mine Area, scale 1" to 800'
(2) A Longitudinal Projection of Ore Knob Mine, scale 1" to 200' (map shows two-dimensional configuration of massive ore shoot)
(3) Typical cost section of the ore shoot at station 1600 West (Drawn on bottom of longitudinal projection at scale 1" to 100')
(4) Ground magnetic map, scale 1" equals 400'
(5) Ground electro-magnetic map, scale 1" equals 400'

The geophysical work shown on maps 4 and 5 above was conducted by Mr. John Ward of Toronto, Canada. I am uncertain as to the type of magnotometer used; however, the EM work was done with a Sharp SE 200.

The orebody occurs in a restricted belt (width) containing massive sulfide deposits; belt extends from Virginia into Alabama. Nearly all of the massive sulfide deposits strike approximately North 60 East. The portion of the belt extending into Virginia has been referred to in the literature as the Gossan Lead area. Many massive sulfides have been mapped within this area, the majority of them being pyrite or pyrrohotite occurences containing minor quantities of copper.

Ore Knob is situated in mountainous country between the crest of the Blue Ridge mountains to the southeast, and the Ridge and Valley Province to the northwest. Elevation of the main shaft is slightly over 3,000 feet. Maximum relief in the Ore Knob area is 800 feet; average relief about 400 feet.

The deposit is thought to occupy the intersection of sheer zones in the Carolina and Roan gneisses. It may be referred to as a fissure vein deposit. Gneissic country rocks strike North 64° East and the foliation dips southeast. Average dip of foliation in the country rock, in the vicinity of the orebody, is approximately 60°.

The known orebody is a southwesterly raking lens-shaped oreshoot, approximately 3,000 feet long, 400 feet wide (vertical height), and up to more than 40 feet thick. Its strike is essentially the same as that of the country rock. The angle of rake is 15 to 20°.

Near the bottom of the oreshoot, a second mineralized zone is found in the hanging wall and lies nearly parallel to the main ore zone (see typical cross-section). This is called the South vein. A section of the south vein and main vein imparts a trough-like configuration to a large portion of the orebody.

Within the orebody the important sulfide minerals are pyrrohotite, pyrite, chalcopyrite and sphalerite. The sulfides occur in intimate mixtures or in zones in which pyrrohotite, pyrite, or chalcopyrite predominates. The former is usually the case. The orebody contains an average of about 32% total sulfides, of which about 16% is chalcopyrite. The individual zone in which one sulfide predominates does not seem to be restricted to any particular part of the total orebody. The entire orebody pinches and swells considerably. There are no obvious changes in mineralogic trends from top to bottom of the orebody.

On the longitudinal plans, a number of holes are shown near the southwest end of the oreshoot. Although the holes contain unencouraging copper quantities, the intersections were zones containing massive sulfides which would vary from approximately 20 to 30%.

I have attempted to outline as briefly as possible the information you will need in designing a geophysical program. It is my feeling that geophysical work in a belt extending along strike of northeast and southwest, even beyond the limits of the property, would prove fruitful. This, in effect, searches for ore in the same plane in which the present oreshoot is situated. There may be orebodies occurring nearby in planes which parallel the Ore Knob shoot but may be stratagraphically higher or lower, i.e., southeast or northwest of the plane in which the known shoot occurs.

Inasmuch as time is important in this investigation, I will look forward to hearing from you as soon as possible.

Warmest personal regards.

Sincerely,

C. O. Ensign, Jr.
Chief Geologist

COE:jm

CC: Mr. James Boyd ✓
Copper Range Company

J. B.

OCT 2 1962

TO	V	IN.
R.A.		
J.B.	✓	
H.C.		
G.M.G.		
C.N.		
J.O.C.		
FILES		

September 19, 1962

Dr. Willard C. Lacy
Department of Geology
University of Arizona
Tucson, Arizona

Dear Bill:

It was indeed a pleasure having the opportunity to visit with you briefly at the Gatlinburg A.I.M.E. meeting. I enjoyed meeting your charming wife.

I am enclosing herewith two Longitudinal Projections of the Ore Knob Mine - one on a scale of 1" to 200' and the other on a scale of 1" to 100'. The 1 to 100 scale map shows all of the diamond drilling done to date from the surface.

In addition, I am enclosing copies of four reports pertaining to this deposit. These are the only reasonably detailed reports in existence.

The orebody occurs in a restricted belt (width) containing massive sulfide deposits; belt extends from Virginia into Alabama. Nearly all of the massive sulfide deposits strike approximately North 50 East. The portion of the belt extending into Virginia has been referred to in the literature as the Gossan Lead area. Many massive sulfides have been mapped within this area, the majority of them being pyrite or pyrrhotite occurrences containing minor quantities of copper.

Ore Knob is situated in mountainous country between the crest of the Blue Ridge mountains to the southeast, and the Ridge and Valley Province to the northwest. Elevation of the main shaft is slightly over 3,000 feet. Maximum relief in the Ore Knob area is 800 feet; average relief about 400 feet.

The deposit is thought to occupy the intersection of sheer zones in the Carolina and Roan gneisses. It may be referred to as a fissure vein deposit. Gneissic country rocks strike North 64° East and the foliation dips southeast. Average dip of foliation in the country rock, in the vicinity of the orebody, is approximately 60°.

The known orebody is a southwesterly raking lens-shaped oreshoot, approximately 3,000 feet long, 400 feet wide (vertical height), and up to more than 40 feet thick. Its strike is essentially the same as that of the country rock. The angle of rake is 15 to 20°.

Near the bottom of the oreshoot, a second mineralized zone is found in the hanging wall and lies nearly parallel to the main ore zone (see typical cross-section). This is called the South vein. A section of the south vein and main vein imparts a trough-like configuration to a large portion of the orebody.

Within the orebody the important sulfide minerals are pyrrohotite, pyrite, chalcopyrite and sphalerite. The sulfides occur in intimate mixtures or in zones in which pyrrohotite, pyrite, or chalcopyrite predominates. The former is usually the case. The orebody contains an average of about 32% total sulfides, of which about 16% is chalcopyrite. The individual zone in which one sulfide predominates does not seem to be restricted to any particular part of the total orebody. The entire orebody pinches and swells considerably. There are no obvious changes in mineralogic trends from top to bottom of the orebody.

On the longitudinal plans, a number of holes are shown near the southwest end of the oreshoot. Although the holes contain unencouraging copper quantities, the intersections were zones containing massive sulfides which would vary from approximately 20 to 30%.

Basically, our problem at Ore Knob is to explore for extensions of the present orebody, or for orebodies which may occur in planes parallel to the present shoot, either stratagraphically higher or lower, but in the near vicinity of the mill site. This is an approach to a localized problem, rather than a regional problem. The big question statistically, how many surface drill holes are necessary to find another Ore Knob type deposit should one exist nearby. (The word "nearby" is certainly not definitive and I, for one, don't know what limits to place on it.) Is the statistical approach to drilling applicable to this area? As we discussed, I fully realize that insufficient information may prevent the building of a reasonably good mathematical model. In that event, a statistical approach may be a poor way to expend time and money. I look forward to your advice and recommendations in this regard.

After you are through with the maps and reports, would you please return them, inasmuch as we have limited copies.

Warmest personal regards.

Sincerely,

COE:jm

C. O. Ensign, Jr.
Chief Geologist

CC: Dr. James Boyd

HEINRICHS GEOEXPLORATION COMPANY
MINERAL ENGINEERING CONSULTANTS AND CONTRACTORS
GEOPHYSICAL, GEOLOGICAL AND ECONOMIC APPRAISALS
TUCSON, ARIZONA

WALTER E. HEINRICHS, JR.
E. GROVER HEINRICHS

PHONE: MAIN 2-4202
908-908 WEST GRANT ROAD
MAIL: P. O. BOX 5671

J. B.

OCT 2 1962

TO	V	IN.
R.A.		
J.B.		
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G.M.G.		
C.N.		
J.O'C.		
ACCTG.		
SALES		

September 20, 1962

Mr. C. O. Ensign, Jr. Chief Geologist
Copper Range Company
White Pine, Michigan

Dear Mr. Ensign,

Walt is currently out of town so I will endeavor to answer your letter of September 18th.

In reviewing the data you sent, there would appear to be a strong magnetic anomaly associated with the mineralization, undoubtedly due to the high pyrrohotite content. The offset of the anomaly to the southwest from outcrop suggests that the sulfides in the upper reaches of the vein may be oxidized. This immediately suggests the possibility that a self-potential survey might give definitive results, but perhaps this method has been tried at the Ore Knob without success. I would think that the cultural activity (power and pipe lines, etc.) in the area would preclude the successful application of any of the electromagnetic techniques including Afmag. About the only method that shows real promise of successful application other than the magnetics and the possibility of S. P. mentioned above, is induced polarization. I have no doubt that I.P. would show at least some definition of the sulfide mineralization and conceivably could delineate ore bodies quite accurately.

As in all geophysical investigations the initial phases of an I. P. survey would be rather experimental; determining the optimum electrode spacing, the effects of cultural features, definition of I. P. effects as related to known mineralization, etc., but I would think that ten field days or perhaps less would indicate the potential effectiveness of an I. P. survey. In this light I would recommend that you consider such a program in an area of known mineralization. In selecting the area it should be noted that whereas alternating current power lines present relatively minor problems that are usually easily overcome, direct current power in use at some mines sometimes presents problems which are insurmountable even at relatively large distances from the mine proper (one mile or more?)

Data computation and results are kept current with field operations and there should be no "dead time" for evaluation of results between termination of any experimental phase and the beginning of the exploratory phase.

Initially I would want to try an electrode spacing of 500 ft. followed by a spacing of 250 ft. over the same line or lines. It is necessary to traverse on the surface 3,000 ft. either side of the center in the case of 500 ft. dipoles and 1,500 ft. for 250 ft. dipoles. Conceivably it might develop that an even smaller electrode spacing would be desirable. The lines should be roughly normal to the strike of the mineralized zone and centered about one electrode spacing either side of the zone. No electrode should be located within one half an electrode spacing of a grounded power line pole and paralleling any grounded power line should be avoided if possible.

Advance brushing of lines might be economically desirable although only sufficiently for a man to walk a relatively straight line. I would think that the rather rugged terrain would preclude the use of vehicles in running the lines. Surveying of electrode locations is usually accomplished by use of the appropriate length receiver cable.

It would be necessary to bring from Tucson at least one and possibly two technicians besides myself and have available there from one to three helpers. We would have some 750 to 1,000 pounds of equipment with us and at least one and possibly two vehicles would be necessary. It might be desirable to transport equipment and personnel from Tucson in one of our vehicles.

Our charges are as follows:
Field services:---------$300 per operating day.
Standby (inclement weather:----$150 per day.
Standby (equipment failure or other factor for which we are responsible---------N. C.
Travel time: Tucson to Tucson------$150 per day
Vehicle charges: $10 per day plus .10¢ per mile
Personnel travel and living expenses---at cost.

I might note here that self potential as well as D. C. resistivity data are obtained in the normal course of our induced polarization work and may be of definite aid in interpretation. I am sure that you are aware that the I. P. method is based on the rather peculiar electrical properties of sulfides and are not discriminatory of the type sulfide infolved (except that sulfides containing iron such as pyrite, chalchopyrite and phyrrohotite usually give stronger response than the others with almost no response from sphalerite).

I trust that this will be of material aid in preparing a geophysical program and we will look forward to hearing from you in the near future. As of this writing we could have a crew on location within seven days of confirmation from you but this situation can change on very short notice.

Talked with Walt on the phone and he asked me to send you his best regards.

Very truly yours,

HEINRICHS GEOEXPLORATION CO.

Franklin A. Seward, Jr.
Geophysicist

FAS:jh

cc: J. Boyd
Copper Range Company

COPPER RANGE COMPANY
WHITE PINE, MICHIGAN

OCT 2 1962

TO	V	IN.
R.A.		
J.B.	✓	
H.C.		
G.M.C.		
C.K.		
J.O'C.		
ACCTG.		
SALES		
FILES		

September 28, 1962

Dr. James Boyd, President
Copper Range Company
630 Fifth Avenue
New York 20, New York

Dear Jim:

Jack James has completed his structural analysis of the Ore Knob property. We plan a trip to Ore Knob on October 1st in order to review the analysis and study the implications as they apply to future exploration.

I plan to travel on October 1 and be on the property on October 2, 3 and 4, returning to White Pine on October 5, unless conditions should dictate the necessity to remain longer. During or following the trip I will send you a memorandum setting forth recommendations for additional exploration. As I am sure you know by now, we have received a proposal on the I.P. Survey by Franklin A. Seward Jr. of Walter Heinrichs Company. Assuming about 10 days work will be involved in performing an adequate I.P. Survey, the cost will be in the order of $7,800.00. Although this cost seems a little high, I have asked that they do the work for us; particularly, since time is important. Seward will meet me in Ore Knob October 2. At that time, we will firm plans for the program. His crew and equipment should arrive several days later. I anticipate the actual program will begin about October 5th.

Our total exploration expenditure at Ore Knob as per September 28, 1962 will be approximately $25,000.00.

Sincerely,

COE:jm

C. O. Ensign, Jr.
Chief Geologist

THE UNIVERSITY OF ARIZONA
TUCSON

COLLEGE OF MINES
DEPARTMENT OF GEOLOGY

October 8, 1962

Mr. C. O. Ensign, Jr.
Chief Geologist
Copper Range Company
White Pine, Michigan

Dear Chet:

I have studied your letter and the reports that you sent. It is my belief that you have not as yet established a base from which any sort of a statistical analysis can be made. Broad areas in well explored and well exposed areas, such as the Basin and Range Province, or the Precambrian of Ontario have yielded a sufficient number of discoveries that predictions can be made with reasonable certainty as to expected return from any large unit area. However, a large unit area must be selected. In the Rand there is a tremendous wealth of intercepts of a continuous unit, so that the statistical method permits evaluation of much smaller area units.

In the instance of the Ore Knob area, there is at present no valid basis for the use of a statistical approach. However, it might be possible, on the basis of all known mineral occurrences within the Virginia-Alabama belt and comparison with belts of similar type deposits in Vermont, in the Bradshaw Mountains in Arizona, portions of the Front Range mineral belt, etc. This would be a full-scale research project which you could not hope to complete with the time limits confronting you. Also, this would only permit the evaluation of fairly large unit areas.

I would suggest that you lean heavily upon geophysics--magnetics (ground plus air-borne) and electro-magnetics--supported by geochemical work.

In my spare moments I will begin to play with the statistical distribution of these sulphide masses in schist. If they are the result of syngenetic metal deposition which has been segregated by metamorphic processes, then a given rock type should have a consistent concentration of deposits per unit area. However, I am far from convinced as to the validity of this interpretation.

I am returning the reports, under separate cover; many thanks for letting me see them.

With kindest personal regards,

Sincerely,

W. C. L.

Willard C. Lacy
Professor of Geology

P. O. Box 5671
Tucson, Arizona
October 9, 1962

M E M O

From: Walter E. Heinrichs, Jr.

To: Copper Range Company and GEOEX

Re: Appalachain Sulphides Inc.
Ore Knob Mine
Ashe County, North Carolina

GEOLOGY:

No strong correlation of known ore zone with particular rock type or structure apparent on outcrop map.

Section 1600 W suggests fault structure (rather than formational contact?) Actinolite gneiss metamorphism.

MAGNETICS:

Extremely linear mag high (2400 gammas plus) parallel and about 1500' to 2000' south of ore zone has no apparent direct or indirect association with shallower economic mineralization or surface rock type. However, a possible, at least indirect, association could still exist at depth.

Smaller mag low (2000 gammas minus) parallels the so called ("vein outcrop"?) in the No. 1 shaft area. This appears natural, but possible artificial causes cannot be completely ignored because of proximity to surface facilities. Same applies to narrow high (2175 gammas plus) which crosses the slag dump immediately south of the above low. If these features are natural, they both can be easily explained by combinations of SE dip and SW plunge of the vein, plus possible alteration and geometric factors involved.

Off hand, this suggests that particular attention should be placed on the area of the similar 200 gamma minus low which trends for about 4000' NE from about 3000' due east of the No. 1 shaft area.

ELECTRO MAGNETICS (E.M.):

Generally the plan data seen seems to correlate well with the known vein outcrop. Results from coverage outside of this area is somewhat disappointing, but is really insufficient for a definite

appraisal. Apparent problems with power lines in some areas and not in others raises some questions which likely could only be answered by the operators involved.

SELF POTENTIAL:

Excellent correlation with the known vein outcrop.

CONCLUSION:

Application of combined Mag and S. P. looks favorable--in fact so favorable as to suggest a catch somewhere, not immediately evident.

Walter E. Heinrichs, Jr.

WEH:jh

1M 10-61 G.P.

COPPER RANGE COMPANY
INTER-OFFICE CORRESPONDENCE

J. B.
OCT 15 1962

TO Dr. James Boyd AT New York

FROM C. O. Ensign, Jr. CE AT White Pine

SUBJECT Ore Knob, North Carolina -- Exploration Activity DATE Oct. 9, 1962

TO	V	IN.
R.A.		
J.B.	✓	
H.C.		
G.M.G.		
C.N.	✓	
J.O.C.		

TO FACILITATE CORRESPONDENCE AND FILING USE SEPARATE SHEET FOR EACH TOPIC

GEOPHYSICAL PROGRAM -- FIRST PHASE

Induced polarization profiles will be developed on five different lines. The selected lines will be at Stations 2000 West, 800 West, 3500 West, 4400 East, and 11000 West. Lines will be run in the above-listed sequence. The lines are oriented in such a way that they will run in a direction approximately normal to the strike of the ore vein, i.e., North 30° West. Lines 2000 West and 800 West will cross the known orebody. Each line will be a length of 6000 feet, except the lines at 2000 West and 800 West. These will be continued in a southeasterly direction to cross two magnetic highs which occur approximately 2000 feet southeast of the orevein.

First experimental electrode spacings will be at 500 feet, and 250 feet, respectively. Conditions may dictate the need to alter this spacing in order to obtain resolution. The line at 11000 West is being run to check a crossover which was detected on the electromagnetic survey performed approximately a year and a half ago. The line at 4400 East is being run to check for a reoccurrence of ore along the plane of the Ore Knob vein northeast of the orebody.

The program outlined is subject to some change should field conditions dictate. Any changes necessary will be left to the discretion of the geophysicists unless major changes are suggested. In this event, the proposed change will be carefully reviewed prior to the actual work.

Just prior to completion of the program outlined above, a complete review will be made of results in order to determine whether or not the program should be discontinued or additional follow-up is needed. We anticipate the completion date to be approximately October 16th. I plan to be back on the property for review several days prior to this.

EXPLORATION DRILLING

The excellent structural analysis by James points to the downward extension of predominant rake as the most likely place to check for more ore. The location of hole N-59 has been selected to intersect the vein at Station 5200 West, elevation 1700.

If hole N-58 makes an ore intersection, we believe it best to further explore the area lying between the hole and the end of the 1120 drift by continuing the 1120 hanging wall crosscut parallel to vein and probing down holes from the crosscut. If hole N-58 does not make an ore intersection it will be necessary to make a decision regarding the placement of N-60. However, N-59 can be started while this decision is being made. Based on the James' interpretation, it presently appears that the location for N-60 will likely be at Station 5200 West but at an elevation approximately 400 feet lower than the N-59 intersection, i.e., 1300 feet. Holes N-59 and N-60 (tentative) will give us considerable spread between the end of the 1120 drift. This spread will lend adequate opportunity to develop ore tonnage if either N-59 or N-60 make an ore intersection.

N-58 should bottom on October 5. N-59 should bottom during the first week in November. The time lapse between the completion of N-58 and N-59 will give us adequate opportunity for further planning. It will also permit us to let geological conditions dictate hole locations.

COE:jm

CC: Nancarrow
F. Seward
J.A. James
W.A. Heinrichs

Drilling operations by Copper Range - Oct. 1962

HEINRICHS GEOEXPLORATION COMPANY
MINERAL ENGINEERING CONSULTANTS AND CONTRACTORS
GEOPHYSICAL, GEOLOGICAL AND ECONOMIC APPRAISALS
TUCSON, ARIZONA

WALTER E. HEINRICHS, JR.
E. GROVER HEINRICHS

PHONE MAIN 2-4202
806-808 WEST GRANT ROAD
MAIL P. O. BOX 5671

J. B.

OCT 15 1962

October 12, 1962

Mr.C.O. Ensign Jr.,Chief Geologist
Copper Range Company
White Pine, Michigan

Re: Appalachain Sulphides Inc.
Ore Knob Area Geophysics.

Dear Chet,

This will directly acknowledge your letter of 18 Sept.1962 previously answered by Frank Seward on 20 Sept.1962.

The maps which you itemized were received along with a few additional ones sent by Frank since he arrived at Ore Knob. The attached memo copy of the original sent to you yesterday, refers to my initial reaction to these data. As of yesterday, the boys had induced polarization (I.P.), resistivity and probably self potential coverage at depth of at least 3500' at 500' spacing and 1750' at 250' spacing, across the known zone on profile line 2000 West. The 500' data resistivity response appears definite and encouraging. At this writing, I had not received the 250' results.

So far almost everything seems to suggest that other occurrences, similar to the known one, can be mapped.

Four questions at the moment:

1.Grover and Frank report you people have established a probable artificial cause for the narrow 200 gamma $\pm$ MAG high which follows the 00 N60°E base line across the southern portion of the slag dump. What are the details on this?

2. Water table is assumed universally fairly shallow, but what about its hardness, quality and variation related to conductivity?

3. What is average depth of oxidation and/or weathering?

4. What is the average physical description and dimensions of a typical cross section of the zone beyond the ore

and well into typical footwall and hanging wall material including such things as gouge, altered products, estimated total sulfides, etc? Or does the vein and ore have very clean walls from massive sulfide to relatively barren rock?

As of now depending on how matters progress in the meantime I plan to meet you at Ore Knob no later than Friday, October 19. Meanwhile it my understanding our objective will be not only to particularly test I.P. applicability, but also to generally appraise what can be done over all.

Until then, best wishes and regards

Sincerely

Walt.

Walter E. Heinrichs, Jr.

WEH:ib

cc: Mr. James Boyd
Geoex at Ore Knob

Jim: Enjoyed our breakfast together at the Mines luncheon in Frisco.

Trust you had a good visit to Colo. Did you get up to Hoel's ranch?

W.

J. B.

COPPER RANGE COMPANY OCT 24 1962

INTER-OFFICE CORRESPONDENCE

Oct. 24

TO Dr. James Boyd AT New York

FROM Chester O. Ensign, Jr. AT White Pine

SUBJECT Ore Knob, North Carolina DATE Oct. 22, 1962

TO FACILITATE CORRESPONDENCE AND FILING USE SEPARATE SHEET FOR EACH TOPIC

During 10-17-62 through 10-18-62 Jack James and I visited Ore Knob. Phil had returned from his meeting in Canada. Walter Heinrichs was on the property to review results of the geophysical work completed to date.

PYRITE CONCENTRATE FROM TAILINGS

Preparation of a pyrite concentrate from tailings was discussed with Eckman and Nameth. Apparently the cost of preparation and shipping makes such a project economically infeasible.

Tailings contain about 100,000 tons of pyrite and 200,000 tons of pyrrohotite. Weatherston advises that he is interested in pyrite only. The sulfur content in pyrrohotite is too low.

The cost of making a pyrite concentrate and delivering it to the railhead at West Jefferson, N.C., would probably be in the order of $5.00 per short dry ton as follows:

Trucking - Ore Knob to W. Jefferson	$1.00	
Milling	2.50	(1)
Reclamation - from disposal area to mill	1.50	(2)
TOTAL:	$5.00	

The above figures do not include an operating profit which should be in the order of $1.00 per ton of concentrate to make the project at all worthwhile. A freight rate (W. Jefferson to White Pine) of $6.13 would be necessary to compete with Noranda. Obviously, this is impractical.

(1) Based on a ratio of 10 tons of tailings to 1 ton of pyrite concentrate. Assumes cost of milling a ton of tailings for $0.25.

(2) Estimated. Includes cost of moving flat cells to base of dam, installation of hydraulic system for moving tailings to mill, and construction of another tailings disposal area. Cost is probably very conservative.

MINE AND MILL OPERATION

Since operation of the Ore Knob property is still showing an operating loss, I discussed the possibility of an immediate shut down with Eckman. He is still of the opinion that October and November will show operating profits and the mine should be continued until all available ore has been broken and mucked out. A substantial reduction in the labor force during October will largely be responsible for operating profits during October and November.

EXPLORATION

Geophysics: I.P. profiles have been completed along lines 2000W and 800W. Excellent response from the orebody was obtained on both lines. No indication of an economically important conductive zone was obtained on that part of either profile which covered the magnetic highs 2300± feet southeast of the ore vein.

Line 3600W was in progress; however, the data had not been plotted.

It was decided to continue the program as first planned viz. completing a profile along 11,000W and another about 3500E (moved from previously selected line 4400E). If there are no favorable responses or configurations similar to those obtained on lines 800W and 2000W, the program will be discontinued. If a response is obtained along one or both lines an additional line will be run on either side of the favorable line to check for continuity. If continuity is obtained the zone will be drilled; if no continuity is obtained, the program will be discontinued.

Completion of the present program should be about October 25th. Inasmuch as I will be in British Columbia, Jack James will visit the property at the time of completion of the present I.P. program to review the work and make recommendations. He will contact me in B.C.

Drilling: Hole N-59 is in progress. Its location was selected for an intersection of vein at 5200-W, 1700' elev. Drilling of N-60 will be necessary to fulfill the guaranteed minimum established in the contract with Longyear. The location of N-60 is still not definite and will await results of the I.P. program and N-59.

Data on hole N-58 and the two underground holes from the 1120 level hanging wall crosscut were reported in Eckman's weekly report Nos. 13 and 14. A third underground hole is being drilled from the 1120 level hanging wall crosscut to intersect the vein 50 ft. above the intersection of hole N-57.

If results from this hole are not encouraging, underground drilling will be discontinued. If results are favorable, further considerations will be essential; i.e., the advisability of additional underground drilling and drifting for creating additional drill stations. These considerations must take into account probability for more ore and the economics involved.

COE:jm

CC: J. A. James

JACK A. JAMES
CONSULTING GEOLOGIST

TELEPHONE: GILBERT 8-0866

211 BELLAIR ROAD
RIDGEWOOD, NEW JERSEY

November 8, 1962

Mr. C. O. Ensign, Jr.
White Pine, Michigan

Dear Chet:

I have your letter of November 5, and we have discussed the subject matter already on the telephone. As you know, I feel your point on regional exploration for other Ore Knob type of deposits in that region is well taken.

The report and maps are all completed except for the intersection of N-59, now being drilled. I thought to hold up printing the maps until this information is available. If however, you prefer to have the report ahead of that time I can assemble it in short order.

Admittedly, the chances at Ore Knob look grim. But you can be satisfied with one thing -- the greatest mistake that could have been made at Ore Knob would have been not to have tried.

Hope to see you soon on your next trip east.

Best regards.

Sincerely,

Jack A. James

HEINRICHS GEOEXPLORATION COMPANY
MINERAL ENGINEERING CONSULTANTS AND CONTRACTORS
GEOPHYSICAL, GEOLOGICAL AND ECONOMIC APPRAISALS
TUCSON, ARIZONA

WALTER E. HEINRICHS, JR.
E. GROVER HEINRICHS

PHONE: MAIN 2-4202
806-808 WEST GRANT ROAD
MAIL: P. O. BOX 5671

November 16, 1962

J. B.
NOV 21 1962

Mr. Chester O. Ensign, Chief Geologist
Copper Range Company
White Pine Michigan

Re: Final Report
Geophysical Envestigations
Ore Knob Mine
Ashe

Dear Chet:

Enclosed are one original and three copies of our report on the work done at Ore Knob, the original field notes (48 pages) and the original computation sheets (16).

Under separate cover we are sending all the original (15) drawings for your file in order that you may be able to make your own reproductions if you wish.

Mr. Jack James and Mr. Phil Eckman expressed a desire for copies of the report, thus the extra copies.

It was a pleasure to work with you on this project and we look forward to working with you again, only then will we hope to really come up with some good new ore.

Your official confirmation regarding whether or not these data might be published will be most appreciated.

Sincere regards and wishes,

HEINRICHS GEOEXPLORATION CO.

Walter E. Heinrichs, Jr.
President & General Manager

WEH:jh
cc: James Boyd

J. B.

NOV 29 1962

Nov 29		
TO	V	IN.
R.A.		
J.B.	✓	
H.C.		
C.E.C.		
C.N.	✓	CM
		Sa

November 27, 1962

Copy sent to Dept of Geology

L. P. Eckman
Appalachian Sulfides, Inc.
Jefferson, North Carolina

COPY

Dear Phil:

Inasmuch as we have decided to liquidate the property, I would appreciate your sending all the books on geology, geologic reports, and maps that are considered the property of Copper Range. We could also use books on surveying, mining, and mining engineering. Mr. Cole would probably like those referring to metallurgy and the extractive industry.

Warmest personal regards.

Sincerely,

COE

C. O. Ensign, Jr.
Chief Geologist

COE:jm

CC: Dr. James Boyd
R. C. Cole

J. B.

NOV 29 1962

Nov 29		
TO	V	IN.
R.A.		
J.B.	✓	
H.C.		
G.M.G.		
C.N.	✓	CM
J.G.C.		
Sa		

November 27, 1962

6 pr [illegible] Geology

L. P. Eckman
Appalachian Sulfides, Inc.
Jefferson, North Carolina

COPY

Dear Phil:

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Warmest personal regards.

Sincerely,

COE

C. O. Ensign, Jr.
Chief Geologist

COE:jm

CC: Dr. James Boyd
R. C. Cole

COPPER RANGE COMPANY
WHITE PINE, MICHIGAN

J. B.

JAN 2 1962

December 27, 1962

Dr. James Boyd, President
Copper Range Company
630 Fifth Avenue
New York 20, New York

Dear Jim:

This is to advise that we have received both Walter Heinrichs' and Jack James' final reports on their activities at Ore Knob. Both did an excellent job. I am keeping the copies here rather than burden the New York files with these; however, if you would care to see them, I would be very happy to send copies. Both reports were very thoroughly prepared.

Warmest regards.

Sincerely,

Chet

COE:jm

C. O. Ensign, Jr.
Chief Geologist

J. B.

JAN 7 1963

Jan 7		
TO	V	IN.
R.A.		
J.B.	✓	
H.C.		
G.F.G.		
C.W.		
J.O.		

1

January 3, 1963

Mr. C. O. Ensign Jr.
Chief Geologist
White Pine Copper Company
White Pine, Michigan

Dear Chet:

A study of Jack James' "Structural Analysis" of Ore Knob emphasizes the difficulty of finding another orebody, or a continuation downward of the present one. The fact that the more recent development and drilling are not shown complicates the analysis of the report. Up to date vertical and horizontal projections of the workings, with a symbol to show ore, would have made it much easier to interpret James' work.

On the 20 scale sections, stoping in several places does not follow the solid sulphide. (This assumes that the solid black lines represent sulphide, but there is no legend to show what the various symbols mean.) For instance, in Section 1500W, DH 9-57 at 2100 ft. elevation shows 50 ft. of almost solid sulphide, with a stope ending 40 feet below and nothing up the dip save DH 8-37, 100 ft. higher. In this section the long drillhole numbered N-7 in the lower sheet lines up with N-14 in the upper sheet. N-7 in the upper sheet is not shown as deep enough to cut the footwall strand. These are details that are perhaps not important in a purely structural analysis, but they should be considered in analyzing local ore chances.

The "Footwall Configuration" projection is interesting. It suggests one possibility that may have been killed by the recent work, of which I have no record. The bend in the footwall at 4000W looks much like the bend at 500E. The axis of this latter bend pitches 10 or 15 degrees west, crossing the orebody at a flat angle. If the footwall bend at 4000W represents a similar condition, there might be another orebody starting at 4500W, at 2100 to 2400 ft. elevation, and pitching West at an angle of 20 degrees or so. In this case, the hypothetical orebody might come down to the 11th Level at about 5000W, and the upper two drillholes of the four old holes at 4300W should have cut mineralization, though perhaps not ore.

It seems to me that wild speculation like that above is about the only way to get any idea as to where other orebodies may be.

The magnetic anomaly 1000 feet southeast of the Ore Knob outcrop

also invites speculation. I understand that there are no outcrops to show whether or not iron staining reached the surface near this anomaly. Even iron-stained fragments in soil or talus might have given some grounds for a theory as to another orebody. In default of any outcrops or rock fragments, I would have been tempted to do a little soil analysis in this area. Two days and a hundred dollars worth of equipment would have been adequate for this, based on work Peter has been doing. Tests might be either for copper or for copper, lead and zinc. In other areas, even where the soil cover is heavy, such surveys have been most illuminating.

As Ore Knob has been definitely given up, the above ideas have no practical value in this case. I have outlined them to show how I would attack such a problem, where evidence is extremely inadequate. Orebodies like the Ore Knob seldom occur alone, and often lines of imaginative reasoning that seem exceedingly tenuous are the only possible clues to more ore. I have never studied such an occurrence without forming some idea as to where other orebodies might occur.

I am sending the James report, with a copy of this letter, to Jack Rand, as you requested.

With best regards,

Yours sincerely,

Ira

IBJ:B
cc: Dr. James Boyd
Mr. John R. Rand(with report)

J. B.

JAN 17 1963

TO	V	IN.
R.A.		
J.B.	✓	
H.C.		
G. T. G.		
	✓	✓
J.C.C.		
FILES		

January 10, 1963

Mr. Chester O. Ensign, Jr.
White Pine Copper Company
White Pine, Michigan

for mining geology

Dear Chet:

I am returning herewith Jack James' Report No. 3, covering his structural analysis of Ore Knob. It may be whipping a dead horse, but in case we are not readily able to dispose of the property, some things may deserve a further look.

While I agree with Jack that the mineralization source lies at depth to the southeast, rather than along plunge to the southwest (see my memorandum of June 15, 1962), his statement that "the distribution of sulphide mineralization is apt to conform to formal structures, and thus, to have continuity downward rather than laterally", is self-contradictory in that the "formal structure" controlling sulphide emplacement is a flatly-plunging, gently folded shear, with lateral, not vertical, continuity within the commercial shoot.

The problem, then, comes down to finding another formal structure, presumably parallel to and down-dip from the Ore Knob shoot, through which mineralizing solutions would have passed on their way up to the Ore Knob shoot. This situation is not hard to imagine in a geologic setting as simple as that at Ore Knob, and had Ore Knob geologists mapped rock types in more meaningful lithologic terms than "gneiss" and "schist", we might have something to work with now. Another dead horse.

While it is nice to call hypothetically on a small basic dike as a source of metals, I do not think that it is at all desirable to ascribe the creation of Ore Knob's "formal structure" to that agency. I would prefer in the Appalachian regions to expect the emplacement of an intrusive as a result of some pre-existing structural control. The Ore Knob shoot certainly exhibits no features suggestive of "splay structures", but does exhibit fold features characteristic in Appalachian geology.

Although, as Jack has noted, the essential orogenic forces leading to the present regional structure can be defined in terms of non-rotational compression, this is not at all pertinent to

our problem, in that during the period of orogeny all kinds of structures developed locally in response to differential stresses around or against earlier or contemporaneous crystalline rocks, within and between sedimentary units of varying competences, along flanks of nappes, and so forth. In Maine, we even have evidence of at least 2 distinct episodes of regional deformation, each with its own regional folding, cleavage, etc., characteristics, and each being a response to a couple or compression from quite different directions of force. Local deformation, then, only indirectly relates to the big orogenic push, and must be defined on the basis of local structures.

In this respect, it is my opinion that the Ore Knob fold structure is only one of many similar nearby structures, like a school of fish, and within a reasonable distance from Ore Knob these fold structures will be generally parallel; the spacing between them should be roughly predictable, given some meaningful structural/lithologic data to work with. Rupture at Ore Knob, as shear sub-parallel to bedding or foliation, is the specific item which has allowed sulphide emplacement. While we cannot suggest that a similar shear is associated with each or even some of the other folds that must exist in the local system, we can say that since the sulphides had to have an access channel of some kind to get into Ore Knob, our immediate hope for more ore will most logically lie along that channel in an underlying (down-dip) fold.

Thus, while Jack would call on random basic intrusives as sources of both mineralization and structure, and go forth with magnetometer to find intrusives, I would merely note that some source of mineralization at Ore Knob did exist, and go forth with magnetometer to try to find subjacent structure by careful litho-logic/structural investigation in the fairly immediate area of the known shoot.

With respect to Jack's "Footwall Configuration", there is only one item of interest that I can see, specific to the search for down-dip structure, although the diagram is interesting in other ways relative to the known shoot. The interesting item, however tenuous it may be, is that Hole No. 250, at elevation 2320, 1045E, suggests a return to "normal" dip on the mineralized structure, down-dip from the area of flattening on which commercial

mineralization cuts out. It would be nice to have Hole Nos. 14, 28, 285, and 268 plotted on the Configuration, to see if this return to normal occurs all along the bottom of the shoot.

Unfortunately, the only exploration procedure that can be offered to prove another down-dip shoot is to drill deep holes to intersect below the best part of the present shoot. Without other structural clues to help, these holes would arbitrarily have to follow down the possible "channel" zone to find by luck the place where dip again changed to form another shallow-plunging fold. For this sort of venture, I have earlier suggested acquiring a partner, to soften the expense.

Since I have not seen the reported magnetic map, and do not know anything of its patterns, or of the technique and station spacing employed, I may be way off base, but anyway. I wonder as to the possibility of inferring structure from the magnetics. Thus, where the trough of the present shoot intersects surface at 1500E, there will be a bend in outcrop having a right-hand drag sense. If a similar shoot structure exists down-dip from the Ore Knob shoot, it may show a drag on surface some distance to the northeast; if so, and if found, it can clue the depth at which this new structure will underlie the Ore Knob shoot. Similarly for a shoot up-dip from the known shoot, which will lie to the southwest on strike. Again for structures in the hanging and foot-wall rocks. Lack of surface bedrock exposure pretty much demands structural mapping by magnetometer. Does the magnetic map suggest any folding in surface configuration? Particularly, does the mag map suggest folding at the anomaly reported to be 1000' southeast of the mine? Any kind of fold pattern suggested by detailed magnetics which can differentiate metasediments can be used roughly to predict the presence, depth, and strength of a structure underlying the known shoot, and to justify the gamble of one or two of the suggested deep holes. Other new structures should be followed with I.P. and geochemistry before scout drilling.

So, Jack and I arrive at roughly the same exploration methods, although we would apparently be thinking of quite different things in the interpretation of field results. The fundamental aspect of my search would derive from the known local fact of mineralization at Ore Knob, and the characteristic local repetition of

minor structures in the Appalachian region. The intent would be simply to find another structure, mineralized by the same source as Ore Knob.

If we cannot easily sell the property, possibly we should take another look at our data, to see if a clue has inadvertently been missed.

Yours very truly,

JR

John R. Rand

JRR/wh
cc: Mr. Boyd
Mr. Joralemon

JACK A. JAMES
CONSULTING GEOLOGIST

TELEPHONE: GILBERT 5-0566

211 BELLAIR ROAD
RIDGEWOOD, NEW JERSEY

October 28, 1963

Mr. C. O. Ensign, Jr.
Copper Range Company
White Pine, Michigan

Dear Chet:

The IP field work was completed this past Wednesday and the computations were completed on Thursday moring. I reviewed the results of the program on Thursday afternoon and for a short period on Friday morning.

There was a lack of encouragement in the results for additional work, and the crew was released to return to Tucson. Lines were run at 11,000W, 3600W, 2000W, 800W, and 3600E. The coverage on these lines extended from 2500N to 3500S except for line 2000W where the coverage extended from 2500N to more than 5000S.

Definite patterns of response were detected on lines 800W and 2000W, and a lack of definite pattern of response was the experience on the other lines. It is quite apparent that IP will show mineralization of the Ore Knob type as it exists on lines 800W and 2000W. The corollary to that fact, is that similar mineralization does not exist on lines 3600E, 3600W, and 11,000W.

The electrical properties of the country rock (high resistivity) are such that it is almost certain the penetration at depth was equal to maximum theoretical (1750 feet); indeed, where a conductor existed it may have been more owing to the distortion of the theoretical hemi-sphere. Certainly, the penetration would not have been less than theoretical.

The coverage given to the area by the IP gives negative indications for additional mineralization

(212) 586-0300

COPPER RANGE COMPANY
630 FIFTH AVENUE
NEW YORK, N. Y. 10020

CHESTER O. ENSIGN, JR.
PRESIDENT

CRX

MAR 11 1974

March 5, 1974

Reply to White Pine Copper Company
White Pine, Michigan 49971

Mr. Wade E. Vannoy, Jr.
Attorney at Law
P. O. Box 393
West Jefferson, N. C. 28694

Dear Mr. Vannoy:

Thank you very much for your letter of February 26 regarding the "Ore Knob" properties in Ashe County, North Carolina. I have read Philip Eckman's letter with substantial interest and I think the concepts he expressed are quite reasonable.

At this time, Copper Range Company is so involved in other matters that it would not be practical for us to think in terms of negotiating to acquire "Ore Knob." I do, however, appreciate your bringing the matter to our attention.

If our interest should change in the future, I will get in touch with you.

Sincerely,

COE

Chester O. Ensign, Jr.

COE:ec

bc: W. S. Cavender
R. Leone - Ray: My reply to Mr. Vannoy is self-explanatory. However, in your search for flux, you might keep Phil Eckman's viewpoint in mind for further consideration at some time in the future.

Report on

THE ORE KNOB MINE OF APPALACHIAN SULFIDES, INC. ORE KNOB, NORTH CAROLINA

By

Chester O. Ensign, Jr., Chief Geologist

ENSIGN

March 20, 1962

Dr. James Boyd, President
Copper Range Company
630 Fifth Avenue
New York 20, N. Y.

Dear Jim:

Enclosed herewith is my report on the Ore Knob Mine of Appalachian Sulfides, Inc.

By copies of this letter I ask Ira, Bill, and Jack to send you their comments and recommendations. I am sure that these will be most helpful in formulating a final decision.

Sincerely,

C. O. Ensign, Jr.
Chief Geologist

COE/jmb

Copies to:

I. B. Joralemon
Wm. P. Nicholls
J. R. Rand

Report on

THE ORE KNOB MINE OF

APPALACHIAN SULFIDES, INC.

ORE KNOB, NORTH CAROLINA

Copper Range Company

White Pine, Michigan

By

Chester O. Ensign, Jr.

Chief Geologist

March 20, 1962

CONTENTS

INTRODUCTION

During the period January 23, 1962, through January 27, 1962, the writer visited the Ore Knob Mine of Appalachian Sulfides, Inc., situated in Ashe County, North Carolina. Purpose of the visit was twofold; first, to determine how long White Pine can expect to receive chalcopyrite concentrates from Appalachian Sulfides, Inc., and second, to investigate the possibility for extensions to the Ore Knob Mine or the occurrence of additional orebodies near by. Both possibilities are believed to be quite good.

The Ore Knob Mine is situated approximately 8.2 air-line miles east of Jefferson, North Carolina, or about 12 highway miles from the railhead at West Jefferson, North Carolina.

Appalachian Sulfides, Inc., is a wholly owned subsidiary of The Nipissing Mines Company, Ltd., in which Patino of Canada, Ltd., is a substantial owner (about 1,097,362 shares).

The information presented herein was obtained from various members of the Appalachian Sulfides, Inc., salaried staff. Although most of the information is thought to be factual and reasonably accurate, some may be subject to considerable error. This note of precaution is offered in the event we proceed further. The financial information will certainly require refinement and verification.

SUMMARY & CONCLUSIONS

Extraction of ore from the end of the 1120 level SW drift, ore along the lower margin of the main orebody, and additional ore near the northeast end of the main orebody assures White Pine a supply of chalcopyrite concentrate through August, 1962.

Hardly any geological or geophysical work has been done which could prove or disprove the possibility for extensions of the orebody or the occurrence of other orebodies in the immediate vicinity. The regional and local geologic settings seem favorable for the occurrence of more ore.

local structural setting

The total capital investment in the Ore Knob Mine is expected to be returned by mid-1962 according to the Mine Manager. Depreciation, development expenses, and depletion have resulted in annual tax losses. The total amount presently available for carry-over is approximately $700,000.00. This could represent a substantial asset to a purchaser.

It is believed that Nipissing will sell Appalachian Sulfides, Inc., for scrap or near scrap value. Perhaps in the order of $350,000.00 or less, which would include surface and mineral rights.

Valuation, making no provision for tax losses but for annual payment of Federal Income Tax, shows a return of capital in 1.5 years and a DCF rate of return of 60% plus. The economic

potential is considerably more favorable if the tax loss is applied.

Careful economic analysis may reveal that the tax loss carry-over is a sufficient asset to justify purchase of the company without proving appreciable additional reserves.

RECOMMENDATIONS

I recommend that we approach Nipissing at once in an effort to negotiate an arrangement for ultimate acquisition of Appalachian Sulfides, Inc.

Two possible arrangements are worthy of consideration:

(1) A six-months' option to purchase the company at a fixed price. Nipissing should agree to continue operation of the mine and mill during the option period, even if a decreased production rate is necessary. During this period Copper Range would be able to make a detailed financial analysis of the company. Sufficient geological and geophysical work could be accomplished to detect the possibility of an extension to the present orebody.

(2) A 30- or 45-day option to purchase the company at a fixed price. During this period Copper Range should be able to make a financial analysis sufficient to determine whether or not the tax loss carry-over is asset enough to justify purchase of the company without proving extensive additional reserves.

In the latter case, operation of the property could probably be continued by the present staff, inasmuch as the majority are local people. Very few of the salaried employees are permanent Nipissing staff people.

PRESENT ORE RESERVE

During my visit in July, 1961, Mr. Phillip Eckman, Mine Manager, stated that Appalachian Sulfides, Inc., would be lucky if the ore reserve lasted until mid-1962. Since then, additional ore has been encountered near the end of the 1120 level SW drift, and at shallow depth near the northeast end of the orebody (Plate I).

The remaining mineable reserve is now estimated at approximately 135,000 extractable tons. At the present mining rate of 925 tpd, the reserve will last through August, 1962.

Ore exists below the 1120 level drift between two faults shown on Plate I. The tonnage has not been determined. There are no plans to mine this part of the reserve.

PAST GEOLOGICAL & EXPLORATION WORK

During July, 1962, the only exploration work in progress was continuation of the 1120 level SW drift. The drift was being continued in a southwesterly direction in hopes of encountering more ore. Obviously, this approach fails to recognize the dominant rake of the orebody. At the time of my January visit driving of the drift had been discontinued and no exploration work was in progress.

There are no plans to explore for a possible extension down rake. Recently, however, three or four drill holes have been planned for a limited area near the northeast end of the orebody.

No detailed geological work has been done in the Ore Knob area by the U. S. G. S. or Universities. The U. S. Bureau of Mines made an investigation of the mine in 1948.(1) Twenty holes were diamond drilled. All but four of these failed to intersect the orebody.

Appalachian Sulfides, Inc., has done a limited amount of surface geological mapping. They have also run limited ground EM and ground magnetic traverses in the immediate vicinity of the mine. Strong EM and magnetic responses were registered at the northeast end of the orebody.

EXPLORATION VIEWPOINT -- NIPISSING

Apparently Nipissing is reluctant to expend exploration funds, particularly in the United States. Eckman stated that Nipissing feels it easier to buy an orebody than find one. There is a lot to be said for this viewpoint, but I believe the expenditure of exploration money is well worth while in seeking extensions of known orebodies or other orebodies within a known district. This seems particularly true of the Ore Knob area since it lies within a belt of massive sulfide deposits (of the Ducktown type) extending from southwestern Virginia to eastern Alabama.

Eckman and geological staff feel that the mine and near vicinity have not been properly tested. They believe additional

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(1) Ballard, T. J., & Clayton, A. B., Investigation of the Ore Knob Copper Mine, Ashe County, North Carolina, R.I. 4341, Sept. 1948.

exploration bets exist and would favor further exploration expenditures.

There are several reasons for Nipissing's reluctance to expend exploration funds in North Carolina: (1) They have recently purchased an interest in the New Brunswick property formerly owned by St. Joseph Lead Company. They are engaged in development work and prefer to place their money in this venture and development, and production from Copper Rand Chibougamau in which they owned 484,000 shares as per December 31, 1960; (2) They use the geologic consulting firm of James and Buffam who do not favor further exploration expenditures in North Carolina.

W. F. James is a director of both Nipissing and Patino.

ASSETS OF APPALACHIAN SULFIDES

The total capital investment to date is approximately 2.9 million dollars.

Surface & Mineral Rights

About 550 acres of surface and 2,000 acres of mineral rights are owned outright. Certain of the mineral acreage in the southwest end of the tract carries an obligation requiring Appalachian Sulfides, or its successors and assigns, to pay a $0.05 per ton royalty to the former owners on rock mined from the property.

Physical Assets

The major physical assets consist of mining, milling, and shop equipment and supplies; six staff houses; one office building; hoist house (with two compressors); crusher house; mill (1,000 tpd); shop; changehouse; warehouse; 2000-foot capacity hoist with two in balance 4-ton skips; etc. In addition, there is a soft ball diamond, swimming pool, and 3-hole golf course on the property.

Tailings

The present tailings pond contains 300,000 recoverable tons of pyrrhotite - pyrite concentrate which runs slightly in excess of 90% combined iron and sulfur. Test work previously done by Appalachian Sulfides indicates that the concentrate will contain about 40% sulfur and 50% iron and can be made with relative ease. Although freight to White Pine would be prohibitive, there may be a potential market within the general area. Tennessee Copper Company previously showed an interest in the concentrates for use in acid manufacture. They may still be potential customers.

Waste Rock

The State and County Highway Departments purchase waste rock for use as road metal. Apparently there is a ready market for the rock if crushed. Eckman calculates a gross value of approximately $20,000.00 in present waste rock piles.

EMPLOYEES -- MANAGEMENT AND LABOR

There are presently 200 employees of which 20 are salaried. The organization is non-union. Union representation has been voted down on two occasions. The wage scale is moderate. Majority of employees are local residents. Most of the miners are farmers. Management and labor relationship seems excellent.

GEOLOGY

Ore Knob is situated in mountainous country between the crest of the Blue Ridge Mountains to the southeast and the Ridge and Valley Province to the northwest. Elevation of the main shaft is slightly over 3,000 feet. Maximum relief in the Ore Knob area is 800 feet; average relief is about 400 feet.

The deposit probably occupies the intersection of shear zones in the Carolina and Roan gneisses. It may be referred to as a fissure vein deposit. The gneissic country rocks strike N 64° E and the foliation dips southeast. Average dip (schistosity) of country rock in the vicinity of the orebody is generally less than 60°.

The known orebody is a southwesterly raking lense shaped ore shoot approximately 3,000 feet long, 400 feet wide (horizontal ft), and up to more than 40 feet thick. Its strike is essentially the

same as that of the country rock. The angle of rake is 15° to 20°. The northeast end of the orebody exhibits a slight dip to the southeast, whereas the dip becomes nearly vertical toward the center. Dip varies considerably throughout the length of the orebody. The change in dip varies from 60° to vertical.

Near the bottom of the ore shoot a second mineralized zone is found in the hanging wall and lies nearly parallel to the main ore zone. This is called the south vein. Intersection of the south vein and main vein imparts a trough-like configuration to a large portion of the orebody.

Flexuring exhibited by changes in dip and the intersecting fault planes, both steeper dipping than foliation of country rock, are probably very important factorsin the localization of ore.

> "Within the massive sulfides of the orebody are found rounded and rotated fragments of quartz and silicified and epidotized country rock. Contacts with these fragments are often sharp, though usually they show some evidence of replacement by ore minerals. These fragments may represent remains of breccia blocks which have been partially or almost wholly replaced."(2)

Within the orebody the important sulfide minerals are pyrrhotite, pyrite, chalcopyrite, and sphalerite. The sulfides occur in intimate mixtures or in zones in which pyrrhotite, pyrite, or

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(2) Brown, H. S., Geology of the Ore Knob and Elk Knob Copper Deposits, North Carolina, Student Report, 1956.

chalcopyrite predominates. The latter is usually the case. The orebody contains an average of about 32% total sulfides of which about 17% is chalcopyrite. An individual zone in which one sulfide predominates does not seem to be restricted to any particular part of the total orebody. The entire orebody pinches and swells considerably. There are no obvious changes in mineralogy from top to bottom of the orebody which suggests the improbability of an ore extension down rake.

EXPLORATION POTENTIAL

The regional and local geologic setting suggests a possibility for the occurrence of more ore.

The most outstanding possibility seems to be additional ore along a projection of the predominant rake at depth below elevation 2,000 feet. Nothing has been done to investigate this. It is possible that the present orebody may be greatly restricted near the end of the 1120 level SW drift and will open into a larger orebody down rake. The orebody may even pinch out completely and reoccur at depth.

A second possibility is the occurrence of other nearby orebodies lying parallel to and in the same plane as the known orebody (Plate I).

A third possibility is the occurrence of other orebodies of the same type within the general area. These would probably strike parallel to country rock foliation but could be stratigraphically higher or lower than the Ore Knob deposit. A number of other occurrences have been reported. One such deposit is at Elk Knob situated about 8.6 air miles north of Boone in Wautauga County.

The regional geologic setting, distribution of many massive sulfide deposits in a narrow belt extending from Virginia to Alabama,[3] and numerous copper shows within a 15-mile radius of Ore Knob strongly suggest the probability for other chalcopyrite deposits. It is incompatible with my exploration thinking to accept the Ore Knob deposit as a unique, singly occurring orebody.

VALUATION

In preparation of a preliminary valuation, it is assumed that an exploration expenditure[4] of $250,000.00 will result in the discovery of 1,250,000 extractable tons of ore yielding 33 recoverable pounds of copper per ton. This is the same size target as the Ore Knob deposit.

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(3) The Ducktown district is situated within this belt.

(4) Treated as development and expensed over two years.

Production at 1,000 tpd and a market level of $0.30 suggest a return of capital in 1.5 years and a DCF rate of return of 60% plus. Remaining assumptions upon which valuation is based are enumerated in Appendices A through D.

Table I

Analysis of Income & Cash Flow on a 30¢ Market

(Figures given in thousands of dollars.)	First Year	Second Year	Third Year	Fourth Year	2/10ths of Fifth Year
Net Sales - Concentrates[1]	2,242	2,242	2,242	2,242	448
Expenses:					
Operation Costs @ $6.00 per ton	1,800	1,800	1,800	1,800	360
Development Costs	125	125			
Depreciation	81	97	119	160	33
Totals	2,006	2,022	1,919	1,960	393
Income Before Taxes	236	220	323	282	55
Federal Income Taxes:					
Net Income Before Tax	236	220	323	282	55
Less Depletion Allow. 50%	118	110	161	141	27
Taxable Income	118	110	162	141	28
Tax @ 30% on first $25,000	7.5	7.5	7.5	7.5	7.5
Tax @ 52% on excess of $25,000	48.5	44.5	71.5	60.5	1.5
Total Federal Income Tax	56	52	79	68	9
Net Income	180	168	244	214	46
Add Back Depreciation	81	97	119	160	33
Salvage & Scrap Value					35
	261	265	363	374	114
Less Capital Additions	50	50	50	50	
Annual Cash Return	211	215	313	324	114

(1) Production = 1000 tpd; or 56.8 tons concentrate/day;
or 17,650 tons concentrate/year.

Note: In an effort to be as severe as possible in making a preliminary valuation, no provision was made for the tax loss carry-over. Instead, it is assumed that Federal Income Tax will actually be paid.

Table II

DCF - Computation

Year	Cash Flow $	Present Worth @ 60% %	Discounted Cash Flow $
0	(350,000)	100.0	(350,000)
1	211,000	75.2	159,000
2	215,000	41.3	89,000
3	313,000	22.7	71,000
4	324,000	12.4	40,000
5	114,000	06.8	8,000
	+827,000		+17,000

DCF Rate of Return = 60% +

EXPLORATION METHODS

The first exploration approach should be an investigation for extension of the known deposit down rake. Angle holes drilled from the surface to intersect a projection of the rake at depth are subject to a high degree of error. Results from such holes could be inconclusive. Drill hole deviation could be responsible for missing the projected target.

As a first phase exploration effort, the following approach is recommended:

(1) Projection of the long axis of the orebody. This should be made by a careful structural analysis. Analysis should take into consideration flexuring reflected by changes in dip within the orebody and the intersection of the fault planes where known. A number of different projections will be necessary in making the analysis.

(2) Drilling a vertical hole 300 feet SW of the end of the 1120 level SW drift to pass 100 feet below the projection, an angle hole at 650 feet aimed to intersect the projection, and a third vertical hole at 1,000 feet. In the hole, EM would be run on each. If massive sulfides occur within 200 feet of any hole, an EM response should be registered. With luck, any or all of the three holes above could intersect ore.

Further exploration would be dependent upon results of the preliminary steps above.

Estimated cost of the preliminary phase -- $35,000.00 to $40,000.00. This estimate is based on 5,800 feet of diamond drilling at $5.00 per foot and $6,000.00 for the EM program.

APPENDIX A

Calculations

Assumptions:

(1) Extension of Orebody = 1,250,000 tons extractable ore

(2) Average Recoverable Grade = 1.65% copper (33#)

(3) Costs:

Mining	$3.50 per ton
Milling	1.25 per ton
Freight	.21 per ton
Other	1.04 per ton
Total	= $6.00 per ton

(4) Annual Mining Rate (300 days/year)

@ 1,000 tpd = 300,000 tons ore;
17,650 tons concentrate

(5) Mine Life

@ 1,000 tpd = 4.2 years

(6) Estimated Purchase Price

Total Assets Including
Surface & Mineral Rights = $350,000.00 (See Appendix C)

(7) Average Ratio of Concentration = 17 : 1

Estimated Truck Freight - Ore Knob to Railhead at West Jefferson = $0.30/ton mile

Estimated Distance = 12 miles

therefore

30¢ x 12 miles + 17 (Ratio of Conc.) = $0.212/ton of ore

Ratio of Concentration

Concentrate = 28% copper (560 lbs./ton)
Ore - Recoverable Cu = 1.65% (33 lbs./ton)

therefore

560 ÷ 33 = 16.97 call 17.

APPENDIX B

Price of Chalcopyrite Concentrates

Copper - less 1.0 unit @ electro price less 2.0¢

Gold - less 0.01 oz. @ mint price

Silver - less 0.5 oz. @ Handy & Harmon, New York

Iron - deduct SiO_2 + Al_2O_3, balance @ 6¢/unit Fe

Sulfur - deduct 1/2 Cu, balance @ 6¢/unit S

	Market			
	25¢	30¢	32¢	35¢
Copper	$124.20	$151.20	$162.00	$178.20
Gold	2.10	2.10	2.10	2.10
Silver	2.18	2.18	2.18	2.18
Iron	1.80	1.80	1.80	1.80
Sulfur	1.26	1.26	1.26	1.26
	$131.54	$158.54	$169.34	$185.54
Less: Treatment Charge	15.00	15.00	15.00	15.00
	$116.54	$143.54	$154.34	$170.54
Less: Freight	16.53	16.53	16.53	16.53
	$100.01	$127.01	$137.81	$154.01

APPENDIX C

Cash Outlays

Purchase Price:

Land	$25,000
Mineral Rights	25,000
Depreciable Assets	300,000
	$350,000

Development Expenses:

1st Year	$125,000
2nd Year	125,000
	$250,000

Equipment Replacements:

1st Year	$50,000
2nd Year	50,000
3rd Year	50,000
4th Year	50,000
	$200,000

Salvage Values:

Land	$25,000
Depreciable Assets	10,000

Recoverable @ 4.2 Years

APPENDIX D

Life of Property -- 4.2 Years

Depreciation Schedule:

(Figures given in thousands of dollars.)	Year 1	2	3	4	Part 5
Purchase & Depreciable Assets:					
300,000 less salvage	69	69	69	69	14
Year 1 Replacement	12	12	13	12	1
Year 2 Replacement		16	15	16	3
Year 3 Replacement			22	22	6
Year 4 Replacement	—	—	—	41	9
Totals	81	97	119	160	33

FOLDER CONTAINS

PLATE 1

Report on

THE ORE KNOB MINE

by

N. Rivard and O. Scholl

Foreign Copy

Report on

THE ORE KNOB MINE

Jefferson, North Carolina

by

Norman R. Rivard*

and

Otto Scholl**

*Mine Superintendent,
Champion Mine, Copper Range Co.,
Painesdale, Mich.

**Mine Captain,
Champion Mine, Copper Range Co.,
Painesdale, Mich.

GENERAL EXAMINATION OF THE ORE KNOB MINE JEFFERSON, NORTH CAROLINA

Purpose and Scope of Examination:

The purpose of my examination of the Ore Knob mine was to obtain a general operating knowledge of the property and, more specifically, to observe present mining methods, proven ore reserves, probable and possible ore reserves, and possible future development prospects. For the most part the contents of this report are only presented in a general way except for the mining aspect. Mr. Otto Scholl, Mine Captain of the Copper Range Company's Champion Mine, has written a short report on the mining aspects of the Ore Knob mine, a copy of which report is attached.

Geography:

Information available in Copper Range Company files.

History:

Legal, productive and financial history available in Copper Range Company files.

Geology:

The Ore Knob mine is a fissure vein deposit having a general strike of N 65° E and dip of 65-70° SW. The host or country rock is granite gneiss. Mineralization of copper has been through replacement of the original gneiss by sulphides, the main copper sulphide ore being

chalcopyrite. From mine observations there is a pronounced thinning and thickening of the vein both vertically and horizontally within short distances in the vein. In general Ore Knob mine management thinks the vein is pinching out rapidly beyond 2500 W (see mine map). Assuming this is true the present mine strongly would indicate a local ore shoot with a definite rake.

From my observations three possibilities exist for the proposed pinching out of the vein beyond 2500 W:

1. Since the country rock is Upper Precambrian, most of the vein has been eroded off and the bottom limit of economical ore has been reached;

2. The present mined area may only represent a local ore shoot in the vein as is the case in many fissure vein deposits. It is also very possible the entire vein is only a "finger" vein from a much more extensive ore body at depth. In such a case it would not be unusual to have the present structural conditions near 2500 W;

3. The rake of the vein may be steeper at depth.

No structural changes were observed to form a conclusion which of the three possibilities exist. There has not been enough development work to support any of the three possibilities.

Ore Reserves:

As of May 1, 1962, Mr. Phillip Eckman, Mine Manager, estimated the proven ore reserves were 77,545 tons at 1.86% copper; this estimate was calculated on 26,595 tons broken at 1.77% and 50,950 tons unbroken at 1.91%. The 77,545 tons will be obtained from shrinkage stoping, sublevel stoping and pillar recovery. The areas of present mining are shown in red on the map. In view of my examination of the property I feel this figure is conservative and acceptable. I believe this estimate could be projected to 100,000 tons from my examination of areas A, B, C, and D shown on the map. Mr. Eckman predicted the mine will be depleted as of September 1, 1962 under the present operating program of 77,545 tons of reserve.

Estimate of Ore Reserves:

Proven:	100,000 tons (conservative figure)
Probable:	Block of ore outlined on map and extension or ore beyong 2500 W. Minimum of 64,675 tons @ 1.5-1.75%
Possible:	Beyond 3000 W, below 982 level between 500 W and 1500 W and 3000 W (1.25-1.50%) Recoverable ore from old shrinkage stopes

Mining Methods and Costs:

The accepted method of mining at Ore Knob has been shrinkage stoping. Stope widths have varied considerably in the main vein; and are in excess of 30 feet wide near the keel (intersection of main vein and upper vein). The haulage levels are driven in country rock with loading cross-cuts to the vein. Eimco M-21 loaders fill 2-ton side-dump tram cars. Battery locomotives are used for tramming. The ore is stored in a storage pocket at the shaft station. In general, drill machines, drill steel, caps and blasting agents are the same as used in the Champion Mine. One could not observe any definite drill pattern either in shrinkage stoping or sub-level stoping due to the limited amount of mining.

Surface Equipment:

The surface equipment including hoist, compressor, shops, etc. are in very good condition.

Underground Equipment:

In general underground equipment was not kept in an orderly manner. The entire underground operation appeared to be quite inefficient. It is my sincere belief that underground efficiency could be improved 15 to 20%.

Past Mining Program:

In general the ore body has been "high-graded"; the ore body has not been exploited to the fullest extent for the overall benefits of the company; an excessive amount of marginal ore was not exploited due to high operational costs. The present mine workings are rapidly being destroyed by pulling crown pillars of high grade (see mine map). By pulling the crown pillars such as indicated on the 9th level, probable ore above such stopes as 981-3, 981-4, and 981-6 will only be mined in the future with accelerated development costs. I do not recommend pulling crown pillars at the Ore Knob mine until all future ore possibilities have been studied; this practice should be stopped immediately.

Proposed Mining Method Ore Knob Mine:

The ore body lends itself very well to shrinkage stope mining. A combination of loading chutes and cross-cuts could be used depending on the width of the veins ascertained during development of new levels. The ore appears to be moderately hard; however, with supervised drilling good fragmentation can be obtained using ammonium nitrate pellets. It appears to be more advisable to sacrifice the higher grade and concentrate on an annual production of 240,000 to 300,000 tons, with heads averaging 1.25 to 1.50% copper. The tram cars are at least 50% too small for this type of operation, thus requiring excessive tramming time for a small tonnage.

With respect to the estimated reserves below the 1120 level, if time can be allowed for sound development, it would be advisable to construct dump pockets at the shaft and tram directly on the level; however, a winze is acceptable if additional ore reserves cannot be found elsewhere in the mine.

Mine management estimates 15% dilution in the ore; however, what they consider dilution is mineable ore at the Champion Mine. The hanging is not well defined at the Ore Knob mine since it is not a definite contact similar to the First East lava flow.

Since ore reserves are a wasting asset, any development program should be planned so that the fullest return can be realized from a developed block of ground.

Recommendations:

Upon examining the Ore Knob mine it is my opinion the present active mine is depleted of ore reserves except for 100,000 tons of ore which can be realized from the active workings and a few new development programs in progress; however, the potential of finding additional ore reserves beyond 3000 W are good. With greater efficiency, 125,000 tons of 1.50 to 1.75% copper may be realized from below the 1120 level. The mine definitely warrants additional exploration work.

The Ore Knob Mine is very similar to the Champion Mine at Painesdale, Michigan. The average grade is above 32 pounds per ton as compared to 16 pounds per ton at the Champion Mine. Mining methods, equipment and operating conditions are similar to the Champion Mine; however, the overall mining costs are 33% greater. An efficiency study of the operation appears to be in order prior to purchasing the property to investigate operational costs.

Norman R. Rivard

Norman R. Rivard
Superintendent Champion Mine
Copper Range Company.

May 15, 1962.

GENERAL EXAMINATION OF THE ORE KNOB MINE
JEFFERSON, NORTH CAROLINA

Report by Otto Scholl

Mr. Norman Rivard, Champion Mine Superintendent, and I left Houghton on May 8th for Jefferson, North Carolina, to inspect with Mr. Chester O. Ensign, Chief Geologist of Copper Range Company, and report on the Ore Knob Mine. We arrived at the Ore Knob Mine on May 10th and left on May 11th, arriving back in Houghton on the evening of May 11th.

We spent one and one-half days inspecting the property.

There are several parts of the operation I observed during the visit:

(1) The surface buildings and equipment are in good repair.

(2) The underground production equipment, such as jack-leg machines and rock handling scrapers are also in good repair.

(3) The following changes, I believe, would improve production efficiencies:

  (a) Two miners are working with one machine; use one miner to a machine.

  (b) Increase the footage drilled per machine shift.

  (c) Presently, one train is used for hauling ore and the mucking machine and operator stand by waiting for the train to return. By using two trains, there would be very little stand by time. All cars should be filled to capacity. They were being loaded to 3/4 capacity during my observation.

(d) Use the same shift schedule as is being used at Champion: 7 A.M. to 3 P.M. and 6 P.M. to 2 A.M. for miners and three shifts for tramming.

(e) Remove all ore from stopes that has commercial value, presently some 2.5% ore is left in stopes as waste.

(f) 2.5% and lower grade ore would be commercial if tramming efficiencies were improved.

(g) In cases where the drifts show commercial grade ore, the drift should not be stopped when the vein narrows.

(h) A drift should be driven below the 11th level, this area may have possibilities.

(i) Use longer roof bolts to hold up the hanging wall.

CHAMPION MINE

Tonnage and Costs per Ton for 12 month period ended April 30, 1962

	Tons
Tons Broken	270,138
Tons Milled	295,668
Tons Hoisted	299,423
	Costs per Ton
Sub Drift	$.0258
Breaking	.7905
Level Haulage	.4137
Shaft Haulage	.0712
Underground General	.0969
Unwatering	.1552
Hoisting	.0864
Crushing	.0864
Surface	.0415
Transportation	.4598
Stamping	.8736
Industrial Accident	.0316
Office	.0399
General Expense	.2208
Smelting	.3500
Overhead	.2701
Total Cost per Ton	$4.0134

REPORT ON

THE ORE KNOB MINE OF APPALACHIAN SULPHIDES, INC.

ORE KNOB, NORTH CAROLINA

Donald J. Hathaway

REPORT ON

THE ORE KNOB MINE OF APPALACHIAN SULPHIDES, INC.

ORE KNOB, NORTH CAROLINA

COPPER RANGE COMPANY

WHITE PINE, MICHIGAN

By

Donald J. Hathaway
Geologist

April 27, 1962

GEOLOGY

The ore body at Ore Knob plunges toward the southwest at an average angle of 19 degrees; it dips toward the southeast at an average angle of 80 degrees and strikes about North 81 degrees East. The dip of the vein at the surface outcrop is nearly vertical. With few exceptions the dip of the vein decreases with depth and averages about 58 degrees on the 1120 level.

The deposit appears to be a fault filling fissure vein type with quartz mica and quartz hornblende gneiss as host rocks. The main minerals comprising the deposit are: pyrrhotite, chalcopyrite, pyrite, bornite and native copper with gangue minerals such as quartz, calcite, tourmaline, sphalerite, diopside, phlogopite, biotite, muscovite, chlorite, epidote, orthoclase, plagioclase, apophyllite, and pink garnet. An interesting feature of the pink garnet is that they tend to be found only near the ore and range in size from 1/16 inches to 1/4 inches in diameter. Higher concentration of massive pyrrhotite is found in the upper portions of the ore deposit especially near the 800 level with more massive pyrite concentrations at lower elevations.

The ore body is comprised of two distinct veins, the main vein or north vein and the south vein or hanging wall vein. The two veins join at a depth of approximately 2200 elevation and form a keel. It is my belief that the south vein has a genesis differing from the main vein, namely by

a massive replacement type deposit. There are no known breccia blocks found as is the case in the main vein and there are areas of the south vein that are almost entirely composed of massive pyrite. The footwall and hanging wall show very little, if any, movement along their planes. More evidence to support this point is the greater width of the south vein composed to the main vein and that throughout the entire ore body there seems to be a zoning from high to low with regard to the percent copper around the high concentration of chalcopyrite zones.

There are two normal faults of note (See Plate #1 in pocket.) The throw of these faults has been difficult to calculate exactly and it is the writer's belief that possibly these faults in conjunction with other post ore faults further down the plunge may be of prime interest in the view of potential exploration. It is believed that the ore below the 1180 level is a result of such faulting (See Plate #1 in pocket.) Southwesterly beyond the fault number two (See Plate #1 in pocket) the ore body tends to pinch and swell more intently than in other areas of the mine and this characteristic could be the result of further structural control.

I have read Chester O. Ensign's, chief geologist for Copper Range Company, report on The Ore Knob Mine of Appalachian Sulphides and concur almost wholeheartedly with his findings, the exceptions having been mentioned above.

ECONOMIC CONSIDERATIONS

The writer has the highest regard for the ability of the present mine manager and his staff at Ore Knob. It is felt that there are areas within the mine operation where a raise in the manpower efficiency rate would make for greater end profits.

The most effective mining methods have been shrinkage and bench stoping. Cut and fill stoping was tried but without success.

The property has been geologically mapped and a ground magnet and E.M. surveys made. The mapping and ground magnet survey did not show anything noteworthy. The exact results of the E.M. survey are unknown. The ground magnet survey was only effective from 300 to 500 feet below the surface of the ground. This could not have penetrated to a depth sufficient to expose other ore deposits in the area.

Recent surface diamond drilling was begun in April, 1968. Four holes were drilled to depths ranging from approximately 400 feet to 700 feet. These holes were unproductive.

The old mine dump located approximately 2800 feet northeast of the warehouse (See Plate #1 in pocket) has approximately 10,000 tons of one percent broken muck lying on the ground surface.

The present active mine dump has high grade chalcopyrite scattered throughout it that could perhaps be recovered.

Due to the pillar recovery program now under way, certain areas in the mine have become weakened along the gneissosity planes to the extent that safe mining practices are prohibitive. It bears mention here, that in determining the ore reserve figures in this report thought as to safe mining was given consideration only in a few instances. The safety factor should be given more emphasis as the rock types become less sturdy and require more timber with depth.

The State of North Carolina is interesting from a geological and mineralogical standpoint. (See Enclosure #1 in Pocket.) Near Scotville, North Carolina which is located about 15 auto miles northeast of Ore Knob is a native copper outcrop which I consider worth investigating.

Jen

Copy here not enclosure in pocket

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Washington 25, D. C.

SELECTED BIBLIOGRAPHY ON THE MINERAL RESOURCES, MINERAL LOCALITIES, GEOLOGY, AND MAPS OF NORTH CAROLINA

The U. S. Geological Survey Bulletins and Professional Papers listed in this bibliography that are not marked OP, (out of print) can be purchased for the prices indicated from the Superintendent of Documents, Government Printing Office, Washington 25, D. C. Geological Survey Circulars (free) can be obtained from the Chief of Distribution, U. S. Geological Survey, Washington 25, D. C. U. S. Geological Survey publications can be consulted at many large public and educational institution libraries throughout the country.

The principal publications of the North Carolina Department of Conservation and Development, Division of Mineral Resources are Bulletins, Information Circulars, and Economic Papers. For information on the availability and prices of North Carolina Division of Mineral Resources publications, contact the Division of Mineral Resources, Department of Conservation and Development, State Office Building, Raleigh, North Carolina.

Information on other publications should be obtained directly from the publishing agency.

Most of the articles and reports cited in this bibliography contain additional references.

The leading mineral commodities of North Carolina are stone, lithium, mica, clay, and talc. In 1958 North Carolina led all States in the production of feldspar, sheet and scrap mica, olivine, spodumene, and tungsten, ranked third in talc and pyrophyllite combined, and fifth in kaolin.

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GEOLOGIC AND TOPOGRAPHIC MAPS

Many of the reports listed in this bibliography contain geologic maps covering parts, or all, of the area discussed in the report. The following section gives general information on the availability of geologic and topographic maps covering areas in North Carolina. U. S. Geological Survey maps may be purchased for the prices indicated from the Chief of Distribution, U. S. Geological Survey, Washington 25, D. C.

Index to topographic mapping in North Carolina: U. S. Geol. Survey.

Shows areas in North Carolina for which topographic and planimetric maps are available for public distribution by the Geological Survey. Maps available include the standard series of topographic maps; and the United States series of topographic maps, scale 1:250,000, which is produced by the Army Map Service and published and distributed for civilian use by the Geological Survey. Special maps and sheets of areas in North Carolina are also listed. Full information on prices and ordering of maps is included. The current Index is free on application to the Geological Survey.

Geologic map index of North Carolina, compiled by Leona Boardman and Elaine Watson: U. S. Geol. Survey, 1950, scale 1:750,000. 50¢.

Shows by colored outlines areas in North Carolina for which geologic maps have been published. A text on the margin gives the source of publication, scale, date, and author of each map.

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Mineral Deposits Branch
April 1960

ENCLOSURE #1

Report No. 2 on

THE ORE KNOB MINE OF APPALACHIAN SULFIDES, INC. ORE KNOB, NORTH CAROLINA

By Chester O. Ensign, Jr., Chief Geologist

May 18, 1962

Dr. James Boyd, President
Copper Range Company
630 Fifth Avenue
New York 20, N. Y.

Dear Jim:

This report is to supplement my previous report of March 20, 1962.

The appendices offer calculations supporting economic and tonnage/grade figures presented in the body of the report. They will also allow the geological committee to check and verify information presented.

The report was prepared from information acquired during the visit of Messrs. Ensign, Rivard, and Sholl to the Ore Knob property during the period May 9 through May 11.

A separate report by Rivard is in the final stage of completion and will be sent as soon as possible.

Sincerely,

Chester O. Ensign, Jr.
Chief Geologist

COE/jmb

CC: C. Nielsen
J. R. Rand
I. B. Joralemon
W.P. Nicholls

Erosion

Report No. 2 on

THE ORE KNOB MINE OF

APPALACHIAN SULFIDES, INC.

ORE KNOB, NORTH CAROLINA

By

C. O. Ensign, Jr.

Dated May 18, 1962

Errata

Page 2, Footnote (2): Should read:

For detail of calculations see Appendices II & III.

Table I, Paragraph 3, Sentence 3: Should read:

From Table II total operating costs @ $6.00/ton are $120,000 resulting in an operating profit .....

Addenda

Page 3, Sentence 2: Should read:

Additional profits of approximately $117,000 can be realized on September through December production (See Appendix IV).

Table I: Should be lined in colors as per attached example.

Report No. 2 on

THE ORE KNOB MINE OF

APPALACHIAN SULFIDES, INC.

ORE KNOB, NORTH CAROLINA

Copper Range Company

White Pine, Michigan

By

Chester O. Ensign, Jr.

Chief Geologist

May 18, 1962

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TABLES

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ESTIMATED REMAINING ORE RESERVE

The reserve estimate shown below was made by Donald J. Hathaway. Approximately 310,000 tons of ore remain in place as of April 1, 1962. The ore occurs in stopes or adjacent to present mine openings (see Plate I). It is believed that 54% (167,000 tons) of the reserve can be extracted at a profit.

Ore Reserve as of April 1, 1962

Tons in Place		Ore - Grade Range
105,000	105,000	+ 2.00% Cu
71,600	176,600	1.50 - 1.99% Cu
75,800	252,400	1.25 - 1.49% Cu
57,600	310,000	1.00 - 1.24% Cu

Just how much of the remaining reserve (143,000 tons) can be mined and milled at a profit or break-even level is unknown.

FUTURE PRODUCTION

During our April 18 meeting, Dr. S. P. Ogryzlo of Nipissing Mines Company, Ltd., supplied projected production figures as follows:

Month	Tons Mined & Milled	Actual	Mill Head Grade	Actual	Grade - Recovered	Actual
April, 1962	23,000	23,899	40 lbs./ton	38	38 lbs./ton	35.4
May, 1962	24,000	23,546	40 lbs./ton	37.4	38 lbs./ton	34.8
June, 1962	20,000		38 lbs./ton		36 lbs./ton	
July, 1962	20,000		36 lbs./ton		34 lbs./ton	
Aug., 1962	20,000		36 lbs./ton		34 lbs./ton	
	107,000				38.2 lbs./ton	

These figures were verified during our recent trip. Barring no unforeseen difficulties, the above production is reasonably assured.

Mr. Phillip Eckman, Mine Manager, conservatively estimates the remaining extractable reserve @ April 30, 1962, as follows: (See Appendix I):

		Grade
Tons Broken	26,595	35.4 lbs./ton
Tons Solid (to be mined)	50,950	44.0 lbs./ton(1)
TOTAL	77,545	37.2 lbs./ton
As per 5-31-62	83,603	37.4 " "

Mr. Eckman's estimate makes no provision for mining beyond the end of August. We believe an additional 60,000 to 80,000 tons of profitable production is possible through the remaining four months of the year (see Plate I). In order to be conservative we shall use 60,000 tons at 37.7 pounds of copper per ton, recoverable.

Total estimated production, April through December, is 167,000 tons which will yield 6,100,000 lbs. of saleable copper or about 11,000 tons of chalcopyrite concentrate containing 28% copper.

ESTIMATED OPERATING PROFIT BEFORE DEPRECIATION & TAXES(2)

Year 1962	April - Aug.	Sept. - Dec.
Gross Value of Production	$1,206,000	$700,000
Less: Frt. & Treatment Costs	384,000	250,000
Net Value of Production	$ 822,000	$450,000
Less: Operating Costs	629,000	390,000
Operating Profit	$ 193,000	$ 60,000

Eckman conservatively estimates operating profit for April - August at $162,000. In the section on "Valuation" I used $175,000, i.e. split the difference between Eckman's $162,000 and my $193,000.

The above profit projections are based on Phillips Brothers continuing as sales agent for Ore Knob production until December 31, 1962.

If it is possible to discontinue using Phillips Brothers as sales agent by July 1, 1962, additional profits can be realized. Provided terms of the present White Pine Smelter contract can be applied directly to Ore Knob, an additional $35,000 in operating profits can be realized on July

---

(1) Allowance made for 15% dilution of grade of solid ore.

(2) For detail of calculations see Appendices II and III.

(See Appendix IV)

and August production. Additional profits of approximately $117,000 can be realized on September through December production. Total profit potential through end of year then becomes $387,000 if no provision is made for expensing further exploration or development. If property is purchased by Copper Range, an exploration charge of about $80,000 should be deducted from profit projection. This assumes that the entire $80,000 would be expended by December 31.

VALUATION (Estimated)

	Ensign		Eckman	
	Apr. 1, 1962	Dec. 31, 1962	Apr. 1, 1962	Dec. 31, 1962
Real Estate:				
Surface	$50,000	$50,000*	$50,000	$50,000*
Staff Houses	39,000	39,000*	49,000	49,000*
Watchman's House	2,000	2,000*	1,000	1,000*
Office Building	5,000	5,000*	10,000	10,000*
		$96,000		
Inventory	100,000		100,000	
Mine & Mill Equipment(1)	200,000	200,000*	300,000	300,000*
Other Buildings	12,000	12,000*	25,000	25,000*
Power Co. Rebate(2)	50,000	50,000	50,000	50,000
	$458,000	$358,000	$585,000	$485,000
Add: Operating Profits		235,000**		162,000
		$593,000		$647,000
Less: Shutdown Cost		40,000		40,000
ESTIMATED POTENTIAL RETURN(3)		$553,000		$607,000

* Cleared After Commissions and Selling Expenses.

** Prod. three Dec.
175000
60000
235000

(1) Includes office and shop equipment.

(2) Estimated present value.

(3) Does not provide for exploration expenditure.

The December 31 valuation is shown to reflect possible liquidation cash return if no additional ore is discovered.

The operating profit of $235,000 in column two above assumes a profit of $175,000 through August and $60,000 through the four-month period September - December with Phillips continuing as sales agent.

MANAGEMENT

Eckman stated that he would be willing to continue as Mine Manager if Copper Range desired him to do so. Anticipating the necessity of liquidating tangible assets, he has made a number of contacts and compiled a list of potential buyers. Machinery Center, Inc., of Salt Lake City, Utah, is to make a study and give him a firm liquidation quotation on mine and mill equipment in the near future. Eckman advises that this company buys and sells used mine and mill equipment and guarantees minimum prices on each item. They have previously given him a rough estimate of $300,000. This is money cleared after their sales fee.

Eckman indicated that, if no additional ore is discovered, he would be willing to liquidate the assets for Copper Range at his present salary plus a small commission on the sales price. Legally, we probably could not pay him a commission but could compute bonuses on the basis of say 2-1/2% of sales price. I believe this an excellent way to handle liquidation provided no other commissions are involved simply because he has made many contacts and would have the necessary incentive to get as much money as possible for our Company.

POSSIBLE COST CUTTING

Mining costs at Ore Knob have been running about $4.25 per ton. This seems excessively high. Rivard and Sholl believe that greater efficiencies can be effected and mining costs can probably be lowered appreciably. If additional ore is found, it is essential to see that Ore Knob management takes necessary steps to effect improvements and create efficiencies which will lower costs.

BREAK-EVEN GRADES - POSSIBILITIES FOR MINING LOWER GRADE

Table I shows break-even grades at different levels of operating cost. Present total operating costs are approximately $6.00 per ton. By creating greater efficiencies in mining, it is conceivable that the costs can be lowered 25¢ to 50¢ per ton. If costs can be lowered to $5.75 per ton, it is possible to make a profit by mining 32 lb. rock (1.5% Cu) with Phillips continuing or by mining 29 lb. rock without Phillips. If costs are lowered to $5.50 per ton, it is possible to make a profit by mining 31 lb. rock with Phillips or 27 lb. rock without Phillips.

POSSIBILITIES FOR DIFFERENT CONCENTRATE GRADE (Appendix V)

If and when Phillips Brothers discontinues as sales agent and obligations to Phelps Dodge can be overcome, concentrate grade can be lowered to 13% copper. The mill superintendent at Ore Knob says that this is not only feasible but would result in greater recovery.

At a 13% copper concentrate, White Pine requirements would be 65 tons per day to meet its entire fluxing need (See Appendix V)

Lowering concentrate grade to 13% Cu will increase life of present mineable reserve and yield an operating profit of $23,700 per month at a $16.53 per ton freight rate or $32,300 per month at a reduced rate of $12.00 per ton. A reduced freight rate may be possible according to the White Pine Traffic Department.

EXPLORATION PROGRAM & COST

Since my report of March 20, 1962, the concept of how best to explore for an ore extension along a projection of rake at depth has changed considerably. To assure maximum opportunity of intersecting a possible extension, it appears best to continue driving the 1120 level SW drift a distance of about 1200 feet. Two crosscuts, each 250 feet in length should be driven into the hanging wall -- the first at 600 feet from the point where drifting was resumed and the second at 1200 feet. A "vertical fan" pattern of diamond drill holes, planned to intersect the ore horizon, should be drilled from the end of each crosscut.

A cost of $80,000 is estimated for this type of effort based on the following cost pattern:

1700 feet of drift @ $35.00/foot	= $60,000.00
5000 feet of diamond drilling @ $4.00/foot	= $20,000.00
	$80,000.00

Several other good programs are possible. As exploration time becomes more limited, it will be necessary to revise the above suggested program. It is probably best to consider these after we definitely know when we can expect to begin our effort; however, the possibilities will be outlined by separate memorandum.

In my report of March 20, 1962, the valuation contained a provision for a total exploration and development expenditure of $250,000. After subtracting $80,000 for the preliminary exploration phase, $170,000 remains for developing additional ore. To maintain production, it is assumed that 500 feet of sub-shafting would be required and 2000 feet of development drifting. Costs as follows:

Sub-Shafting - 500 ft. @ $200.00/foot	= $100,000.00
Dev. Drifting - 2000 ft. @ $35.00/foot	= 70,000.00
	$170,000.00

TABLE I

Grade at Which Operating Profit Will Result for Given Operating Cost/Ton

Operating Cost Per Ton	20	24	26	28	30	32	34	36	38	40	45	50
5.25		L	P		P							
5.40		L	P		P							
5.55			L	P		P						
5.70			L	P		P						
5.85			L	P			P					
6.00				L	P		P					
6.15				L	P		P					
6.30				L	P			P				
6.45					L	P		P				
6.60					L	P			P			
6.75						L	P		P			
7.00						L	P			P		
Ore Grade recoverable Grades[1]	16.96	20.35	22.04	23.74	25.43	27.13	28.83	30.52	32.22	33.91	38.15	42.39

Approx. Break-Even Level with Phillips Bros. out.
Approx. Break-Even Level with Phillips Bros. continuing.

Example: With Phillips Bros. out, an operating cost of $6.45 per ton and 27.13 lb. recoverable copper will show an operating profit where 25.43 lbs. recoverable copper would result in an operating loss.

With Phillips Bros. continuing, an operating cost of $6.45 per ton would require 30.52 lbs. of recoverable copper to show an operating profit.

The amount of operating profit can be computed by using Tables III and IV. For example, assume Phillips continues as sales agent and recoverable copper is 33.91 lbs. From Table III net value of production is $145,000. From Table II total operating costs @ $6.00/ton are $120,000 resulting in an operating profit of $25,000 or $1.25 per ton or .0036¢ per lb. of saleable copper. (See Calculations below.)

$$\frac{\$25,000}{20,000 \text{ tons}} = \$1.25$$

$$\frac{\$25,000}{678,200 \text{ lbs. Cu}} = .0036¢$$

(1) Based on 10% grade dilution in mining @ 94.2 mill recovery.

TABLE I

Grade at Which Operating Profit Will Result for Given Operating Cost/Ton

Operating Cost Per Ton	20	24	26	28	30	32	34	36	38	40	48	50
5.25		L	P		P							
5.40		L	P		P							
5.55			L	P		P						
5.70			L	P		P						
5.85			L	F			P					
6.00				L	P		P					
6.15				L	P		P					
6.30				L	P			P				
6.45					L	P		P				
6.60					L	P			P			
6.75						L	P		P			
7.00						L	P			P		
Ore Grade Recoverable Grade[1]	16.96	20.35	22.04	23.74	25.43	27.13	28.83	30.52	32.22	33.91	38.15	42.39

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$$\frac{\$25,000}{20,000 \text{ tons}} = \$1.25$$

$$\frac{\$1,500}{678,200 \text{ lbs. Cu}} = .0036¢$$

(1) Based on 10% grade dilution in mining @ 76.2 mill recovery.

TABLE II

Total Operating Costs - Based on 20,000 tons/month

Production @ Different Increments of Operating Cost/Ton

Tonnage Factor	x	Operating Costs Per Ton	=	Total Operating Costs
20,000		$5.25		$105,000
"		5.40		108,000
"		5.55		111,000
"		5.70		114,000
"		5.85		117,000
"		6.00		120,000
"		6.15		123,000
"		6.30		126,000
"		6.45		129,000
"		6.60		132,000
"		6.75		135,000
"		7.00		140,000

TABLE III

Net Value of Production @ Different Grade of Recoverable Copper.
Based on a 20,000 ton production factor. Phillip Bros. continuing as Sales Agent.

Tonnage Factor		Recoverable Grade (1)		Saleable Lbs. Cu		Gross Value Per Lb. Cu (2)		Gross Value Production	Less Frt. & Treatment(3)		Net Value Production
20,000	X	16.96	=	339,200	X	31.38¢	=	$106,440	$33,920		$ 72,520
20,000		20.35	=	407,000		31.38¢		127,720	40,700		87,020
20,000		22.04	=	440,800		31.38¢		138,320	44,080		94,240
20,000		23.74	=	474,800		31.38¢		148,990	47,800		101,190
20,000		25.43	=	508,600		31.38¢		159,600	50,860		108,740
20,000		27.13	=	542,600		31.38¢		170,270	54,260		116,010
20,000		28.83	=	576,600		31.38¢		180,940	57,660		123,280
20,000		30.52	=	610,400		31.38¢		191,540	61,040		130,500
20,000		32.22	=	644,400		31.38¢		202,210	64,440		137,770
20,000		33.91	=	678,200		31.38¢		212,820	67,820		145,000
20,000		38.15	=	763,000		31.38¢		239,430	76,300		163,130
20,000		42.39	=	847,800		31.38¢		266,040	84,780		181,260

(1) Lbs. copper per ton of rock recoverable (See Table I).
(2) Includes gold and silver values equated to price of copper.
(3) Computed on basis of 0.10¢ per lb. of copper (Past Appl. Suif. Experience).

TABLE IV

Net Value of Production @ Different Grades of Recoverable Copper.
Based on a 20,000 ton production factor and Phillips Discontinuing as Sales Agent as of July 1, 1962.

Saleable Lbs. Cu(1)		Avg. Lbs. Cu/Ton Conc.	=	Tons Conc.	X	Frt. to W. P.	=	Total Frt. Cost/ton	Gross Value Production(2)	-	Less Frt. Charge	=	Net Value of Production	Recoverable Grade (3)
339,200	:	550	=	617		$16.53/ton	=	$10,200	$ 94,400	-	$10,200	=	$ 84,200	16.96
407,000		550		740		$16.53/ton		12,230	113,220	-	12,230	=	100,990	20.35
440,800		550		801		$16.53/ton		13,240	122,550	-	13,240	=	109,310	22.04
474,800		550		863		$16.53/ton		14,260	132,040	-	14,260	=	117,770	23.74
508,600		550		925		$16.53/ton		15,290	141,530	-	15,290	=	126,230	25.43
542,600		550		987		$16.53/ton		16,320	151,010	-	16,320	=	134,700	27.13
576,600		550		1048		$16.53/ton		17,320	160,340	-	17,320	=	143,020	28.83
610,400		550		1110		$16.53/ton		18,350	169,830	-	18,350	=	151,480	30.52
644,400		550		1172		$16.53/ton		19,370	179,320	-	19,370	=	159,940	32.22
678,200		550		1233		$16.53/ton		20,380	188,650	-	20,380	=	168,270	33.91
763,000		550		1387		$16.53/ton		22,930	212,210	-	22,930	=	189,280	38.15
847,800		550		1541		$16.53/ton		25,470	235,770	-	25,470	=	210,300	42.39

(1) Computed on 20,000 Tonnage Factor; taken from Table III.
(2) Computed by : Tons of Concentrate x $153.00 per ton (avg. cost to White Pine).
(3) Lbs. of copper per ton of Rock Recoverable (See Table I).

APPENDIX I

ORE KNOB MINE

ORE RESERVES @ APRIL 30, 1962

Stope	Tons Broken	Tons Solid (to be mined)
202-10	1,584 @ 1.94	
422-4		1,300 @ 2.50
422-6	3,791 @ 1.75	
422-8	5,688 @ 2.08	
562-2		4,000 @ 1.99
562-9	238 @ 1.49	7,900 @ 2.28
700-0		4,000 @ 2.62
842-3		1,100 @ 2.75
980-0		12,800 @ 2.38
981-1	627 @ 2.04	
982-6		1,850 @ 2.00
1120-0	1,387 @ 1.72	5,500 @ 2.00
1121-1		12,500 @ 1.93
1121-6	3,603 @ 1.63	
1121-7	2,594 @ 1.56	
1121-9	4,794 @ 1.58	
1121-10	289 @ 1.41	
Total	26,595 @ 1.77%	50,950 @ 2.20%

Grand total allowing 15% dilution of grade of solid ore --

77,545 tons @ 1.86% copper.

May 7, 1962.

Philip Eckman.

APPENDIX II

Actual figures in ink.

Ore Knob Mine:

Profit Projection (April - August 1962) Using February 1962
Cost Performance and Projected Tonnage Estimate of Eckman.

1962	April	May	June	July	August	April Through August	Unit Costs (2)
Actual	23,899.20	22 546.18	18,512.90		13 315. **		
Est. Mine Tons	23,000.00	24,000.00	20,000.00	20,000.00	20,000.00	107,000.00	
Est. M.H. Grade	38.00	37.40	34.60		33.00		
(lbs/ton)	40.00	40.00 93.2%	38.00 93.0%	36.00	36.00 90.7%	38.2	
Mill Rec. @ 94.2%	37.68	37.68	35.80	33.91	33,91	35.98	
Saleable Cu in lbs.	845,638.00 / 866,640.00	785,888.00 / 904,320.00	595 707.00 / 716,000.00	439,354.00 / 678,000.00	497,818.00 / 678,200.00	3,843,360.00	
Est. Tons Conc. S.D.T @ 28% Cu	1518.51 (27.84) / 1,548.00	1,426.96 (27.54) / 1,615.00	1088.71 (27.26) / 1,278.00	~~1 000.37 (24.88)~~ / 1,211.00	1 000.37 (24.88) / 1,211.00	6,863.00	
Gross Value of Production (1)	265,816.34 / $271,950.00	247, 162.81 / $283,780.00	187,136.46 / $224,680.00	141,747.11 / $212,820.00	$212,820.00	$1,206,050.00	31.38¢
Less: Freight and Treat. Costs	86 145.31 / $ 86,660.00	81, 481.06 / 90,430.00	62,129.70 / 71,600.00	36,416.49 / 67,820.00	67,820.00	384,340.00	10.00¢
Net Value of Production	179, 671.03 / $185,290.00	165,681.75 / $193,350.00	125,006.76 / $153,080.00	105 330.62 / $145,000.00	$145,000.00	$ 821,710.00	
Less: Operating Costs	127, 233.26 / 141,870.00	123,818.53 / 148,040.00	115,748.08 / 117,210.00	120 103.90 / 111,020.00	111,020.00	629,160.00	16.37¢
	Eckman est. ~~37.68~~						
Operating PROFIT before Deprec. & Taxes	$ 43,420.00	$ 45,310.00	$ 35,870.00	$ 33,980.00	$ 33,980.00	$ 192,550.00	.0501¢
	actual -$ 52,437.77	$ 41,863.22	9,258.68	(14 773.28)			
Op. Cost / ton milled	$ 5.32	$ 5.49	$ 6.23	$ 7.05			

Break Even Grade ofor February 1962
34.00 lb per ton mill heads 1.7 % Cu
38.00 lb per ton in mine 1.9% Cu

Figures above based entirely on preparation of a chalcopyrite concentrate.

(1) Equated to price per lb. of copper @ 31.38¢ /lb. Includes Au and Ag values.
(2) Used for computing monthly totals.

APPENDIX III

COMPUTATION OF POSSIBLE OPERATING PROFIT

SEPTEMBER - DECEMBER, 1962

Assume:

60,000 tons production	- September through December
40 lbs. Cu/ton	- Mill Head
37.68 lbs. Cu/ton	- Total Recoverable
Ratio of Conc.	- 14 : 1

therefore:

(1) 60,000 tons x 37.68 lbs. = 2,250,000 lbs. saleable

(2) 2,250,000 lbs. x 31.38¢ = $700,000 Gross Val. Production

Less: Frt. & Treatment = 250,000(1)

$450,000 Net Val. Production

Less: Operating Costs(2) 390,000

$ 60,000 Operating Profit

NOTE: Above operating profit projection is based on assumption that Phillips Brothers continues as sales agent through December, 1962.

---

(1) Computed on basis of 0.10¢ per lb. copper.

(2) Based on $6.50 per ton. Actual costs to date are about $6.00 per ton.

APPENDIX IV

COMPUTATION OF POSSIBLE ADDITIONAL OPERATING PROFIT IF PHILLIPS BROTHERS DISCONTINUES AS SALES AGENT @ JULY 1, 1962

Assume:

60,000 tons production	- September through December
40 lbs. Cu/ton	- Mill Head
37.68 lbs. Cu/ton	- Total Recoverable
Ratio of Conc.	- 14 :

therefore (use Table II):

(1) @ 37.68 lbs. Cu/ton yields = $640,000 Gross Value Production

(2) Less: Frt. only 69,000

(3) 570,000 Net Value Production

(4) Less: Operating Cost 390,000

177,000 Operating Profit

(5) Less: Operating Profit with Phillips Bros. 60,000

(6) September - December $117,000 Additional Profit w/o Phillips

(7) $117,000 + $35,000 (add. profits July & August) = $152,000

NOTE: In computations shown above values in Table II are multiplied by three (3) in order to equal 60,000 tons of production. Example: Gross Value of Production for 37.68 lb. Cu/ton is about $212,000. Multiplied by 3 it becomes $636,000 and is rounded off to nearest $10,000.

APPENDIX V

PROFIT PROJECTION IF CONCENTRATE GRADE IS REDUCED TO 13% COPPER

Remaining Ore - 167,000 tons extractable @ 32.3 lbs./ton recoverable.
All production to go to White Pine Copper Company.

Assume preparation of a 13% Cu concentrate (260# Cu):

(1) Ratio of concentration = 8 : 1

(2) 65 tpd conc. required by White Pine, 7 days per week,
∴ 65 x 7 = 455 tp week.

(3) 455 tp week x 8 ratio conc. = 3640 tons ore/week - mining requirement.

(4) 3640 tp week ore ÷ 5 mining days = 730 tpd - mining rate.

(5) 167,000 tons ore ÷ 3640 = 46 weeks life.

(6) 455 x 46 = 21,000 total tons conc.

(7) 21,000 ÷ 11 = 1900 tons conc./month.

Income to Appalachian Sulfides (Monthly)

1900 tons conc. x $81	$154,000
Less frt. @ $16.53*	31,300
	122,700
Less Operating Costs	
15,800 tons @ $6.25	99,000
	$ 23,700
If frt. reduced to $12/ton*	$ 32,300

* May be able to have this reduced to $12.

B.S.W. BUFFAM 5-15-62

PROSPECTUS FOR MERGER of
NIPISSING & PAT. CO. 5-28-62

Equip	$ 300 000
Bldgs & Houses	100 000
Land	25 000
Facilities	7 000
Inventory	50 000
Power Rob	40 000
	$ 522 000

Geophysical Investigations
at Ore Knob Mine and Vicinity

GEOPHYSICAL INVESTIGATIONS

at the

ORE KNOB MINE AND VICINITY
Ashe County, North Carolina

for

COPPER RANGE COMPANY
White Pine, Michigan

November 1962

by
HEINRICHS GEOEXPLORATION COMPANY
P. O. Box 5671 Tucson, Arizona

TABLE OF CONTENTS

INTRODUCTION

During the month of October 1962, Heinrichs Geoexploration Company conducted induced polarization, resistivity, spontaneous polarization and magnetic surveys at the Ore Knob Mine in Ashe County, North Carolina and reviewed existing electromagnetic, magnetic and spontaneous polarization data. GEOEX personnel involved in the field work were E. G. Heinrichs, F. A. Seward, Jr., and F. F. Hanly with W. E. Heinrichs, Jr. consulting and J. W. Marlatt and C. S. Ludwig assisting in the data review.

Working conditions were technically favorable with no lost time, although the production rate was somewhat less than initial expectations due to a little heavy rain, heavy undergrowth and moderately rugged topography. From a physical property standpoint the area is considered an ideal province for geophysical investigation, particularly by electrical methods.

CONCLUSIONS AND RECOMMENDATIONS

1. Induced polarization and resistivity data over the Ore Knob ore body gave excellent and conclusive results.

2. The existing self potential data, largely confirmed by additional field work by GEOEX, very effectively outlines the limits of the ore body.

3. The previous Sharpe S.E. 200 electromagnetic survey seems to have indicated the ore zone, at least in part, but neither the method nor particular technique used appears to be the optimum application.

4. Magnetic results, in part confirmed by additional field work by GEOEX, does not reveal strong surface anomalism directly assigned to ore deposition. However, there may still be a weak direct correlation of importance as well as some very significant possible indirect relationships. An example of the latter is the long broad high paralleling the mineralized zone in the hanging wall. This is most likely only a regional or rock type feature, but could also be caused by factors either directly or indirectly genetically related to the mineralization. Further conclusions would require additional reconnaissance coverage and study in the area, including some systematic testing of hand samples of ores and country rock for magnetic susceptibility.

5. No geophysical indications approaching in character

or intensity those observed over the known mineralization on Lines 2000 West and 800 West were discovered in the course of the survey over previously unexplored ground. It is therefore concluded that significant additional economic deposition above 1,500 ft., in the ground processed, is very unlikely.

6. In regional reconnaissance exploration in this area, self potential, magnetics and perhaps Afmag (audio frequency magnetics), if the latter demonstrates success in certain required experimental local tests, along with geochemical soil sampling and analysis, would be the best, least expensive and most rapid approaches. More detailed follow-up by induced polarization surveying should be made of any anomalies discovered to aid in selecting drill targets.

INDUCED POLARIZATION SURVEYS

Procedures and Objectives: Preliminary tests were made over the Ore Knob ore body to determine optimum electrode spacing and the response that might be expected from any extension or other similar occurrence that might exist in the area.

Line 2000W, Spread #1 was centered at Station 6N and designed to determine the response over the known ore body as well as to test the ground in the vicinity of a mineralized quartz outcrop near Station 18N. Spread #2 was an extension of this line to the south, centered at Station 29S designed to process the hangingwall to about Station 50S and particularly to test the magnetic anomaly centered at Station 23S. This initial work was run in "double density", that is to say, both spreads were run at two different electrode spacings, 500 ft. and 250 ft. This work determined that a 500 ft. dipole spacing should be sufficient to discover any mineral occurrence of economic significance and that a 250 ft. or perhaps smaller spacing would be required to map in detail any mineralized zones discovered and to plan any drill holes necessary.

Line 800W was centered at Station 10S and designed to test the known ore body and the magnetic anomaly centered at Station 2000S.

Line 3600W was centered at Station 5N and was designed to process the ground at relatively shallow depths above

moderately deep drill information and to confirm said drill hole data.

Line 3600E was centered at Station 5S with the objective of testing the eastern extension of the mineralized trend.

Line 11,000W centered at Station 5N was intended to explore the westward extension of the mineralized trend and to test several E.M. crossovers previously observed.

INTERPRETATION

On Line 2000W, excellent response was obtained over the ore body on Spread #1 of the 500 ft. dipoles. Strongest effects were observed between Station 1N and 4S, moderate effects from 1N to 6N and questionable anomalism from 6N - 16N. This latter interpretation is based on rather high background (?) frequency effects possibly related to weak disseminated sulfides in the country rock in this region, coupled with very high d.c. resistivities. The anomalous region appears to attenuate much more sharply to the north of 6N than to the south and this is interpreted as related to the southerly dip of the vein. Spread #1 of the 250 ft. dipoles in this line again centered at 6N provides even greater definition of the orebody and shows cut-off to be essentially between 1N and 1.5S. There are indications that the results integrate the effects of two separate sources--one located in the immediate region of 1N and the other in the vicinity of 4S. This becomes particularly apparent in the self

potential data. It has been suggested that the effects near 4S are from a known vein in the hangingwall and of no economic importance.

Spread #2 of Line 2000W, 500 ft. dipoles revealed minor questionable anomalism from 19S to 29S and again possibly from 44S to 49S. The 250 ft. spread over this line showed greater contrast particularly between 26.5S and 29S. This feature is interpreted to be one of definite sulfide involvement but narrow and of low grade and not of economic interest. This zone also corresponds to a magnetic low within the high trend but there is no corresponding self potential low.

Line 800S was centered too far south to show the northerly attenuation of the anomaly due to the ore body but the south half of the anomaly which has its principle component between 0 and 5S is almost identical in character with that observed on Line 2000W. There were no other anomalous indications on this line.

Line 3600W showed no significant polarization effects. Minor resistivity contrasts in the region from 0 to 10N and vicinity of 25N are interpreted as being the reflection of the barren structure or host rock.

On Line 3600E only minor questionable polarization was observed between 15N and 20N. The resistivity low and resultant low order metal factor high is tentatively attributed to the

fact that the line in this region crossed the high-sulfides tailings pond.

Again on Line 11,000W only very nebulous polarization effects exist. The E.M. crossovers previously observed are reflected in resistivity lows from 20N to 25N and from 5N extending south in the shallower depth points.

TECHNICAL COMMENT

Selection of a given electrode spacing is determined by the objectives to be reached in a given survey. This spacing will range from very small (50 ft. or less) for very detailed surveys, up to 1,000 ft., or occasionally more, for broad reconnaissance work. Other factors involved in the selection are concerned with the anticipated physical geometry of any possibly existing mineral occurrence which must include consideration of such factors as expected depth of burial to the top of the source, the dimensions of the source itself as well as of its electrical and other physical properties. In general the greater the spacing the greater the maximum penetration and the less the lateral definition. With this dipole-dipole (Eltran) electrode configuration, the maximum theoretical possible penetration is from 1.0 times the electrode spacing in the first separation to 3.5 times the spacing on the 6th separation. In other words, with theoretically IDEAL conditions of completely isotropic-homogeneous resistivity in every direction both lateral and

vertical, (a situation we never have), using 1,000 ft. dipoles, the information obtained in the first dipole separation represents the average electrical composition of the materials from 0 to 1,000 ft; in the third separation from 0 to 2,000 ft; in the 6th separation from 0 to 3,500 ft. Actually, penetration is a function of the absolute resistivity distribution and magnitude which are most often rather complex. In practice, empirical results have shown that under average conditions the depth of penetration may vary from 0.2 to 2.0 times the electrode spacing from first to sixth dipole separation. The I. P. data obtained is plotted at a point that represents the geometric "bottom" of a hemisphere which has a radius equal to ½ the dipole separation, however, it must be emphasized that this value does not necessarily represent the electrical properties at that point, but actually the average of the properties of all the materials within the hemisphere. Furthermore, in the vicinity of sharply contrasting resistivity contrasts the hemisphere will be greatly distorted, often providing for lateral translation of maximums and minimums. Therefore, it is unrealistic to attempt interpretation to a degree of accuracy greater than a minimum of about half the distance between any two adjacent depth points. Fortunately geological (and therefore physical property) contacts are often sharp enouth to create a pattern within the data that lends itself to more or less definite analysis within the limitations above described.

Since we usually only effectively collect our data from the surface with essentially two dimensional coverage, the exact vertical aspects are often the most difficult to analyze. For example, it is very hard to detect the presence of a relatively poor conductor, or non-polarizing horizon, lying below a good conductor or polarizing layer, and if the upper horizon were an especially good conductor there would be no indication what so ever of the lower zone.

In the case of an alternating series of conducting and insulating horizons the affect is to average the electrical properties of the entire section with a somewhat more attenuated resultant than if the whole section were a uniform equivalent of the same averaged conditions from surface to the point of maximum penetration. In the more usual case of non-sulfides, less conducting material, overlying a conducting (sulfides) zone that extends beyond the depth of maximum penetration, the data will show no more than background polarization effects in separations that are smaller than the thickness of the over-burden, with polarization uniformly increasing with depth until certain lateral and vertical limits related to the size, shape and position of the conducting horizon were exceeded.

SELF POTENTIAL SURVEYS

A review of the self potential surveys performed by Appalachian Sulfides indicated the excellent applicability of this method. Even though it may have been demonstrated by previous work that not all major S. P. lows in the area are ore related, we do believe that almost all shallow ore in the area would give good S. P. response. More or less regional or reconnaissance self potential data is gathered in the normal course of I. P. surveying. In addition several detailed profiles were run to aid in the selection of I. P. line locations.

The profiles over Lines 2000W and 800W clearly indicate the known ore body. A detailed survey of a portion of Line 2000W from 9N to 9S on 100 ft. spacing indicated the twin peaked anomaly mentioned above with one peak at about 1N and the other about 4S to 5S. The second peak was not observed on Line 800W although this could be due to the fact that this line was not run on a detail spacing. The S. P. results on the remainder of the I. P. lines may reflect minor localizations or concentrations of oxidizing sulfides and certain regional highs and lows that may or may not be topographically related, but there do not appear to be any features similar in either magnitude, gradient or character to those on Lines 2000W and 800W. An S.P. detail line run on Line 2800W showed a strong regional S.P. high on the south and associated low to the north.

MAGNETICS

A number of detailed magnetic profiles were run to confirm the existing data and to further investigate any relationships between ore mineralization and magnetic anomalies either positive or negative. In general, the previous magnetic work is accurate. As stated previously, the long, broad, but sharply defined magnetic high paralleling the mineralized structure some 2000 to 4000 ft. south of outcrop, is most likely a regional feature related to a particular rock type. However, the spatial coincidence of highest value magnetic closures within an anomalous area with the same relative strike position as the known ore zone, cannot be totally ignored. Also, the apparently rather high magnetic properties of the ore would bear further detail investigation.

SUMMARY

Induced polarization surveys will give excellent results over mineral occurrences similar to the Ore Knob deposit and environs. Reconnaissance application of the method may be somewhat limited by expense but when other methods can be applied such as is the case in this area with self potential, magnetics and perhaps Afmag, I. P. can and should be used as a detail tool to substantiate anomalies obtained by use of the reconnaissance techniques and aid in the planning of drill holes.

Results from the present work did not locate any immediate extensions to the known Ore Knob deposition.

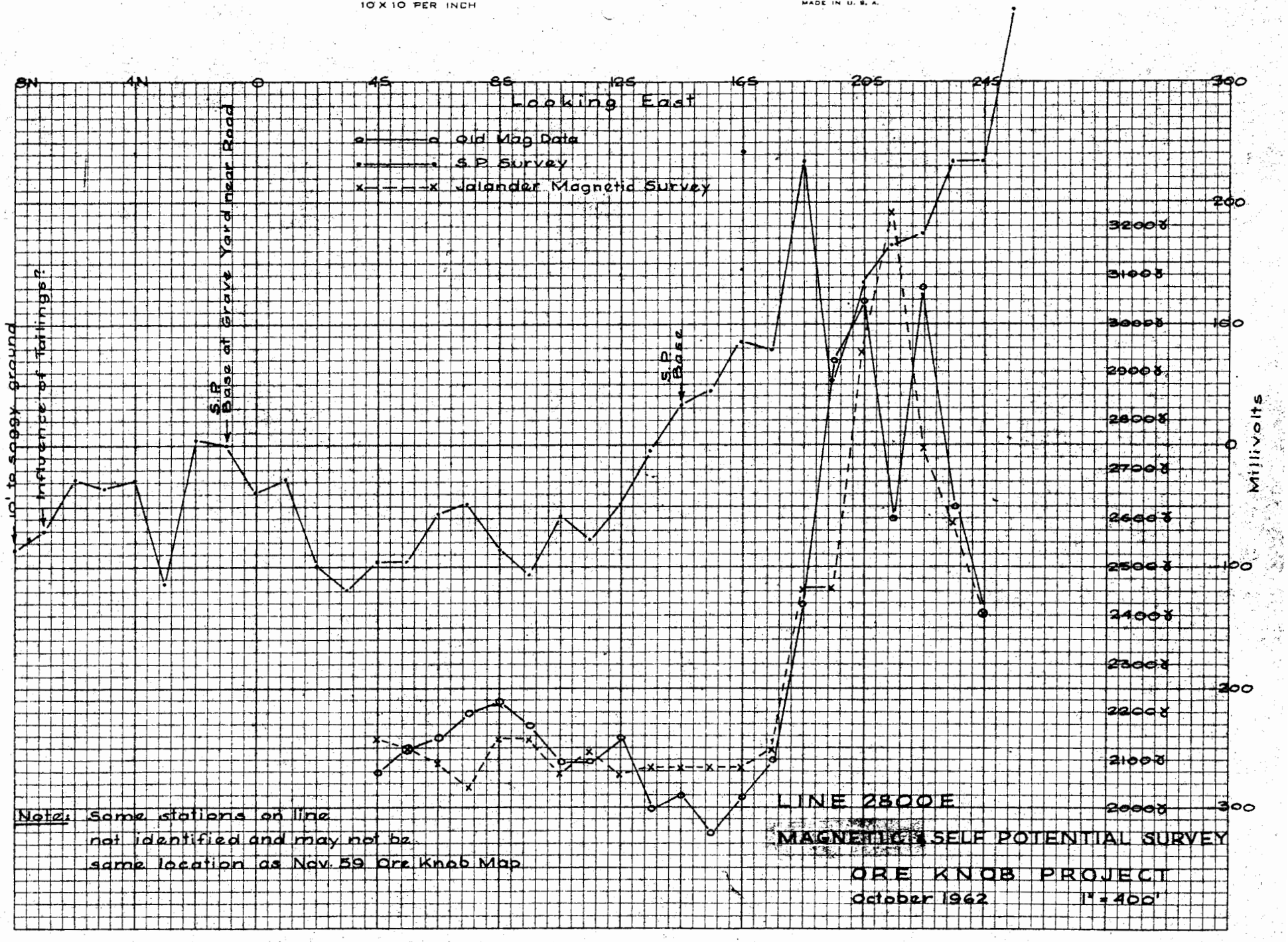
Respectfully submitted,

HEINRICHS GEOEXPLORATION CO.

Franklin A. Seward, Jr.

Franklin A. Seward, Jr.
Geophysical Engineer

P. O. Box 5671
Tucson, Arizona
November 15, 1962



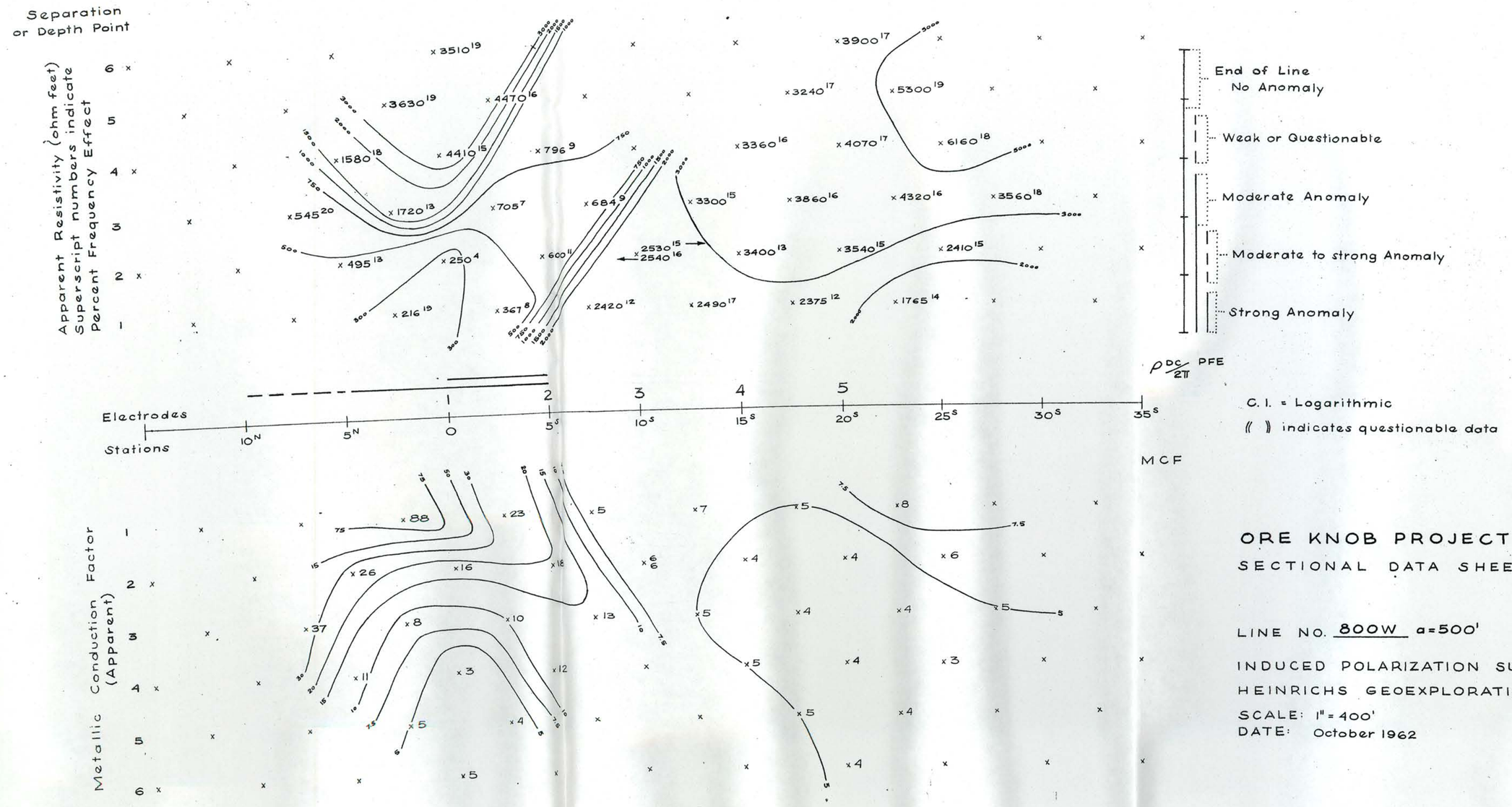
Note: Some stations on line not identified and may not be same location as Nov. 59 Ore Knob Map

LINE 2800E

MAGNETIC & SELF POTENTIAL SURVEY

ORE KNOB PROJECT

October 1962 1" = 400'



C. I. = Logarithmic

(( )) indicates questionable data

ORE KNOB PROJECT

SECTIONAL DATA SHEET

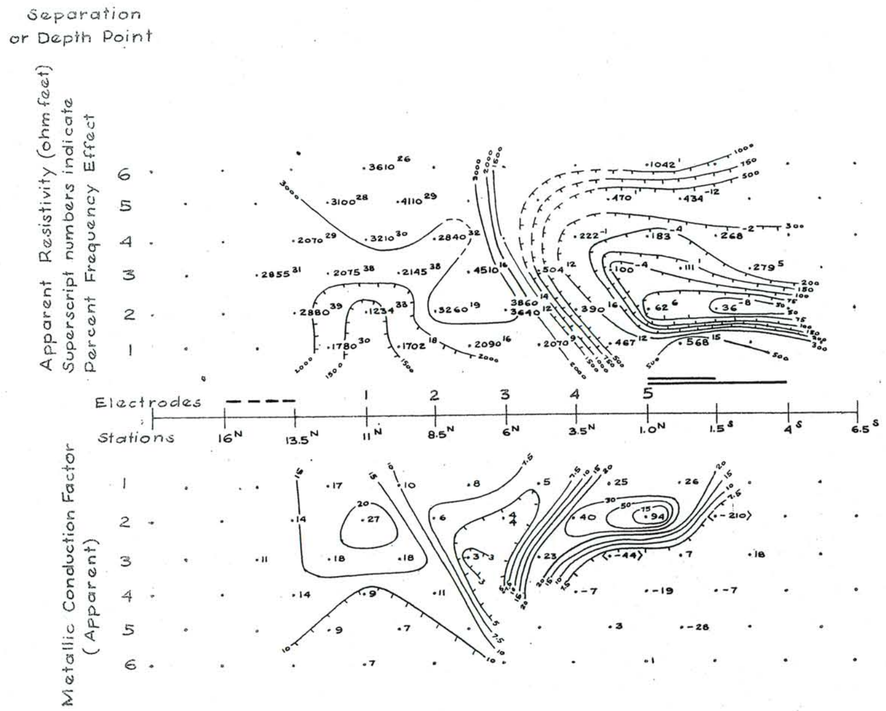
LINE NO. 800W a=500'

INDUCED POLARIZATION SURVEY

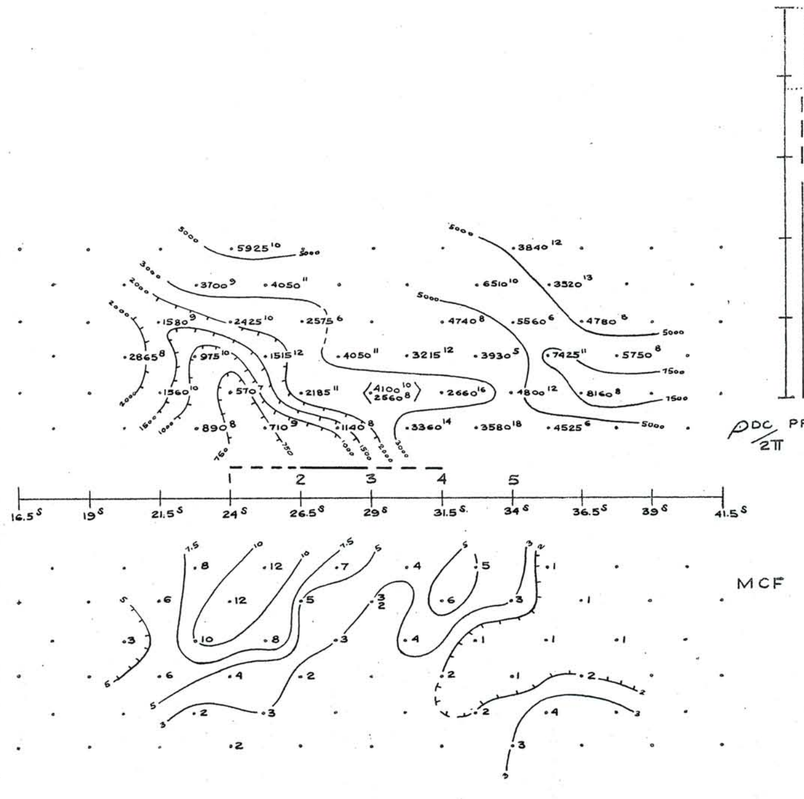
HEINRICHS GEOEXPLORATION CO.

SCALE: 1" = 400'

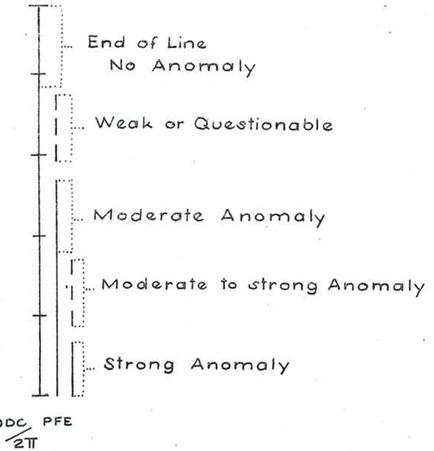
DATE: October 1962



Spread 1



Spread 2



C. I. = Logarithmic
〈 〉 indicates questionable data

ORE KNOB PROJECT

SECTIONAL DATA SHEET

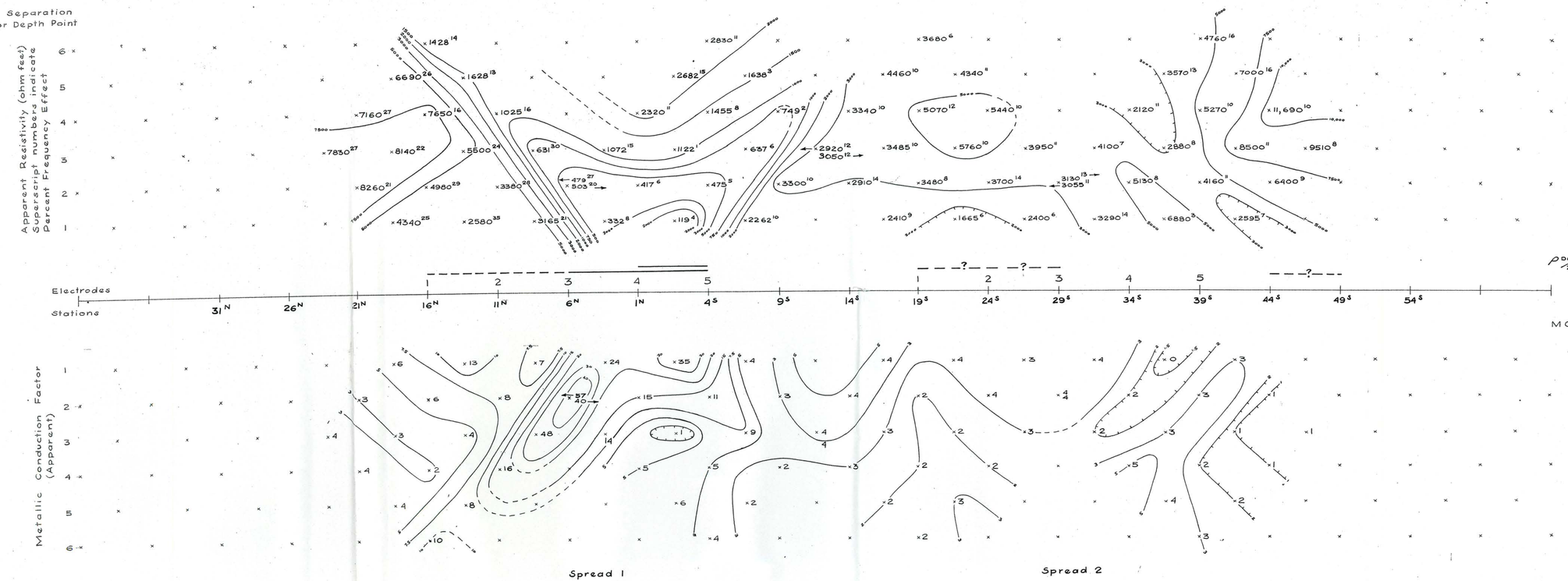
LINE NO. 2000W a = 250'

INDUCED POLARIZATION SURVEY

HEINRICHS GEOEXPLORATION CO.

SCALE: 1" = 400'

DATE: October 1962



ORE KNOB PROJECT

SECTIONAL DATA SHEET

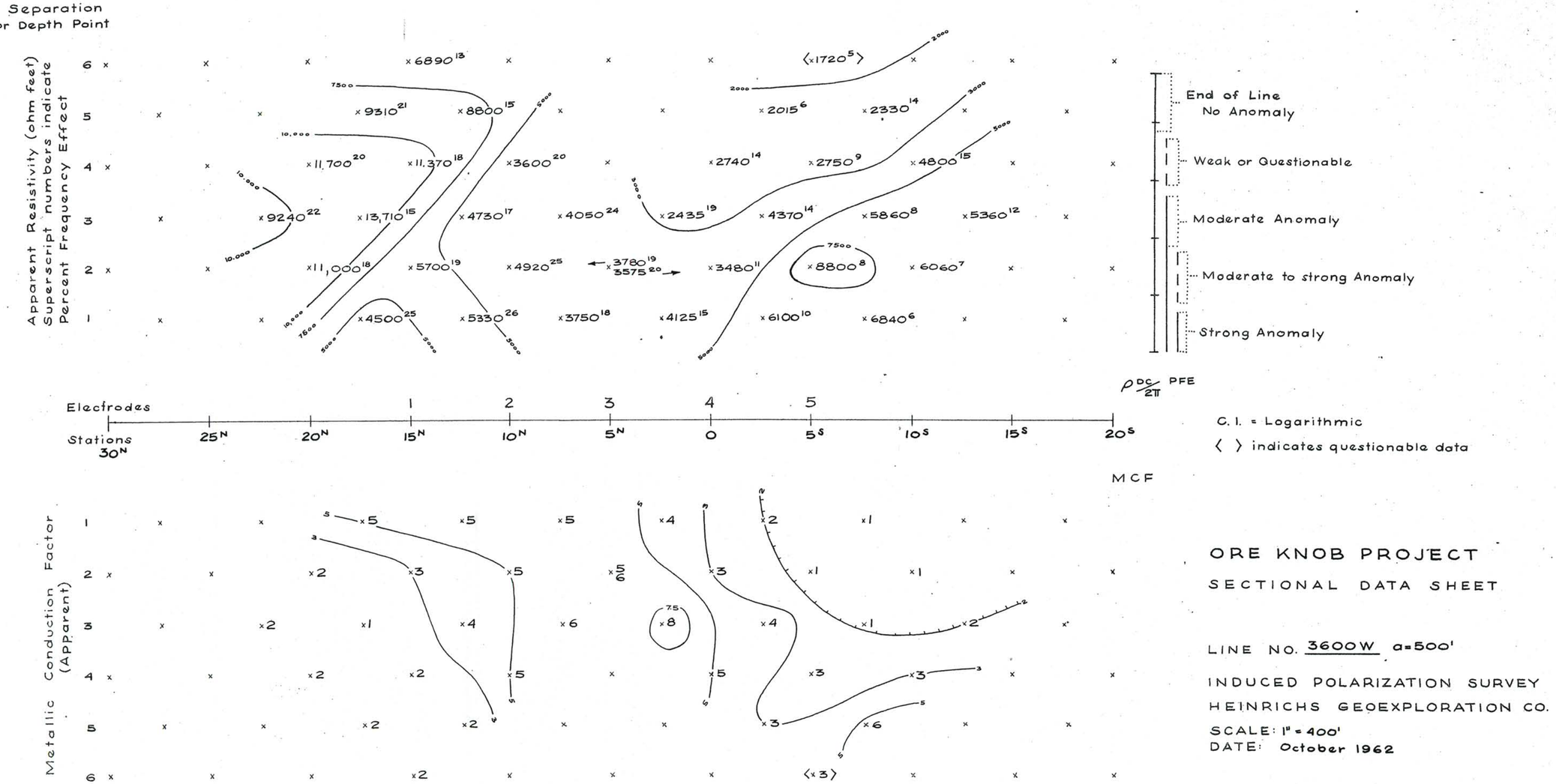
LINE NO. 2000W a = 500'

INDUCED POLARIZATION SURVEY

HEINRICHS GEOEXPLORATION CO.

SCALE: 1" = 400'

DATE: October 1962



ORE KNOB PROJECT

SECTIONAL DATA SHEET

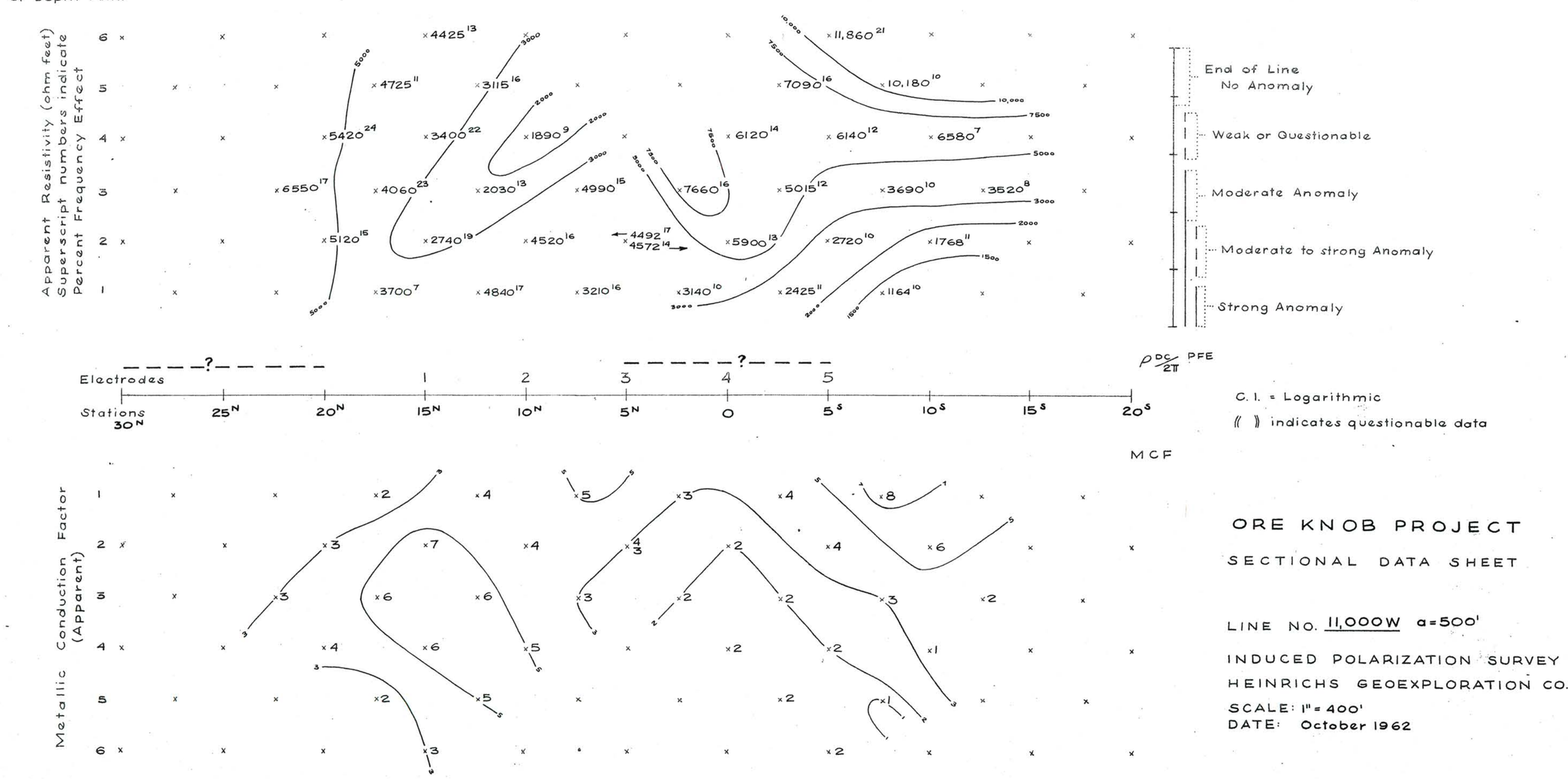
LINE NO. 3600W a=500'

INDUCED POLARIZATION SURVEY

HEINRICHS GEOEXPLORATION CO.

SCALE: 1" = 400'

DATE: October 1962



C. I. = Logarithmic

(( )) indicates questionable data

ORE KNOB PROJECT

SECTIONAL DATA SHEET

LINE NO. 11,000W a=500'

INDUCED POLARIZATION SURVEY

HEINRICHS GEOEXPLORATION CO.

SCALE: 1" = 400'

DATE: October 1962


MILL
SCALES
MILL WAREHOUSE
CORE SHACK
MILLERS SHAFT
ELECT. SHOP
MACHINE SHOP
HOIST & COMP. BLDG.
DRY
WARE-HOUSE
ASSAY OFFICE
6" WATER SUPPLY LINE
6" FIRE LINE
80,000 GAL. TANKS
ENGINE SHAFT
To Jefferson
OFFICE
PARKING AREA
PUMP HOUSE
S. 60° W.
N. 60° E.
No. 2 Shaft
Engine Shaft
Elev. 3000
LEGEND
2.52-14.0' % copper @ horizontal width of D.D.H. intersections.
Ore grade or weak intersection in Main Vein.
Ore grade or weak intersection in Hangingwall Vein.
INSERT — 1121 DRIFT
#2 FAULT
#1 FAULT
DATA USED IN ORE RESERVE CALCULATIONS
5.0' SHRINKAGE STOPE WIDTH
15.0' BENCH STOPE WIDTH
9.5 CUBIC FEET/TON
+2%
HUNG UP MUCK +2%
1.50-1.99%
1.25-1.49 %
APPALACHIAN SULPHIDES, INC.
PLAN & LONGITUDINAL PROJECTION
ORE KNOB MINE
JEFFERSON, NORTH CAROLINA
Scale 1" = 100'
Date 4-1-62

4500 N
4000 N
3500 N
3000 N
2500 N
2000 N
1500 N
1000 N
500 N
I.P. BASE LINE
N 60° E 00° N
500 S
1000 S
1500 S
2000 S
2500 S
3000 S
3500 S
4000 S
4500 S
5000 S
5500 S
6000 S
6500 S
E 8000
N 6000
N 2000
E 12000
E 16000
E 20000
E 24000
N 6000
N 10,000
N 14000
BASE LINE N 30° W 00° E/W
BASE LINE N 30° W 00° E/W
LINE 11,000 W
LINE 3600 W
LINE 2000 W
LINE 800 W
LINE 2800 E
Self Potential & Magnetics
LINE 3600 E
LINE 24000
Spread 1
250 a
(1) 2
(2)
(3) 3
(4)
(5) 4
Spread 2
250 a
(1) 2
(2)
(3) 3
(4)
(5) 4
SLAG
TAILINGS

HEINRICHS GEOEXPLORATION COMPANY
P.O. Box 5671 Tucson, Arizona

LOCATION MAP
INDUCED POLARIZATION SURVEYS &
SELF POLARIZATION SURVEYS
(POTENTIAL)
FOR
APPALACHIAN SULPHIDES, INC.

ORE KNOB MINE
ASHE COUNTY, NORTH CAROLINA

SCALE: 1" = 400	CONTOUR INTERVAL:	REVISIONS
	DATA BY: F.A.S., E.G.H., W.E.H.	
DATE: OCT. 1962	SHEET OF	
DRAWN BY: I.B.	DRAWING NO.:	FILE:

COMPOSITE PROFILES

LINE 800W - Spread I

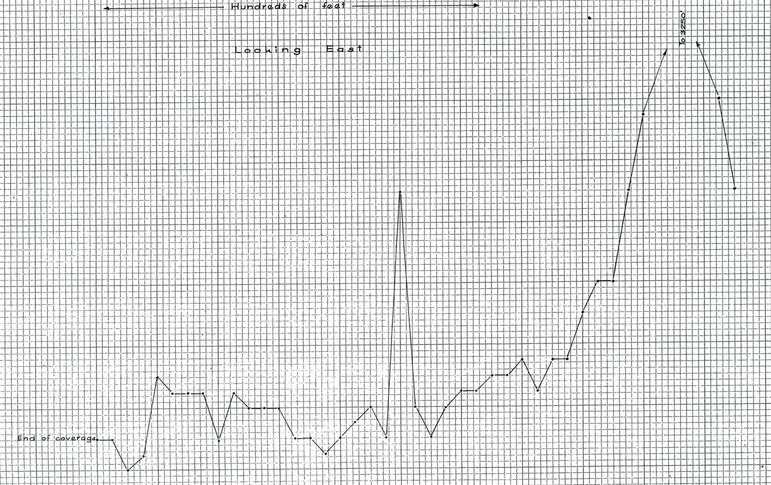
ORE KNOB PROJECT

October 1962 Scale: 1"=400'

Station No. 35N 30N 25N 20N 15N 10N 5N 0 5S 10S 15S 20S 25S

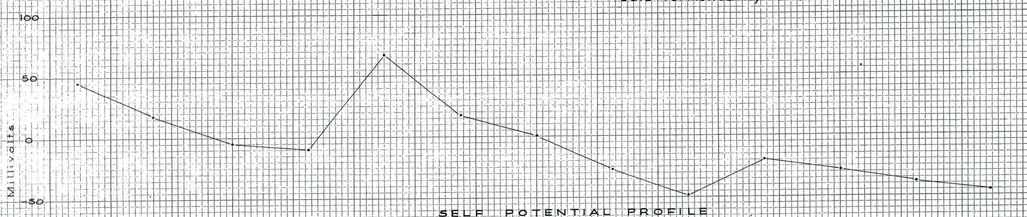
Hundreds of feet

Looking East

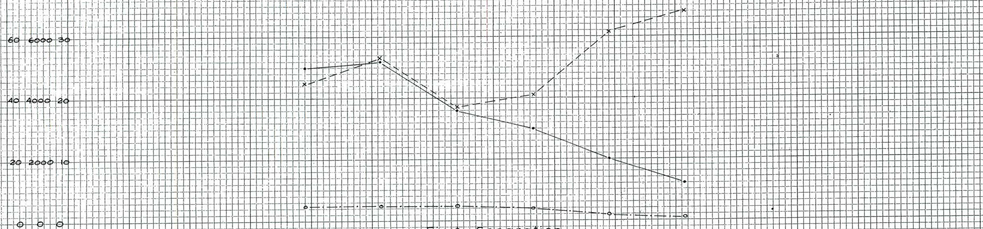


MAGNETIC PROFILE

Data furnished by Client



SELF POTENTIAL PROFILE



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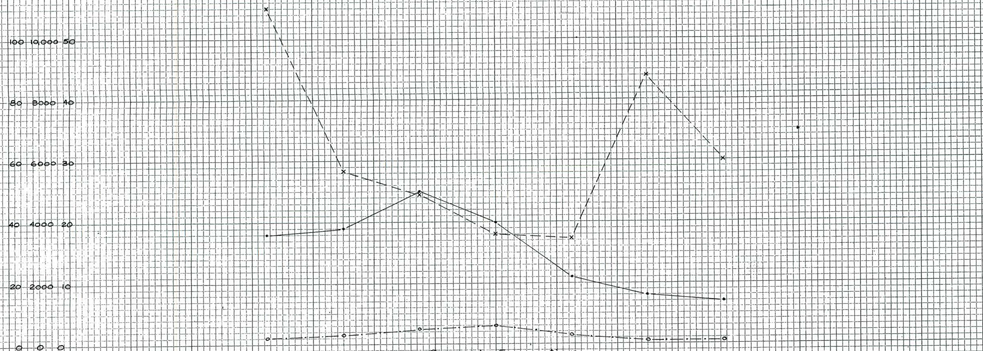

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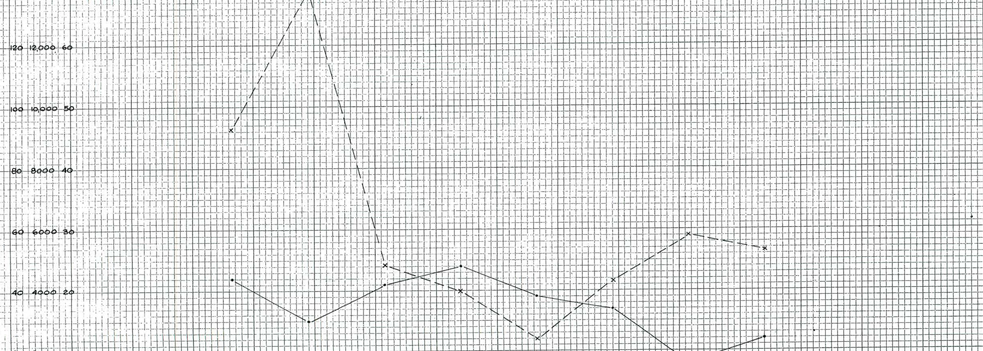

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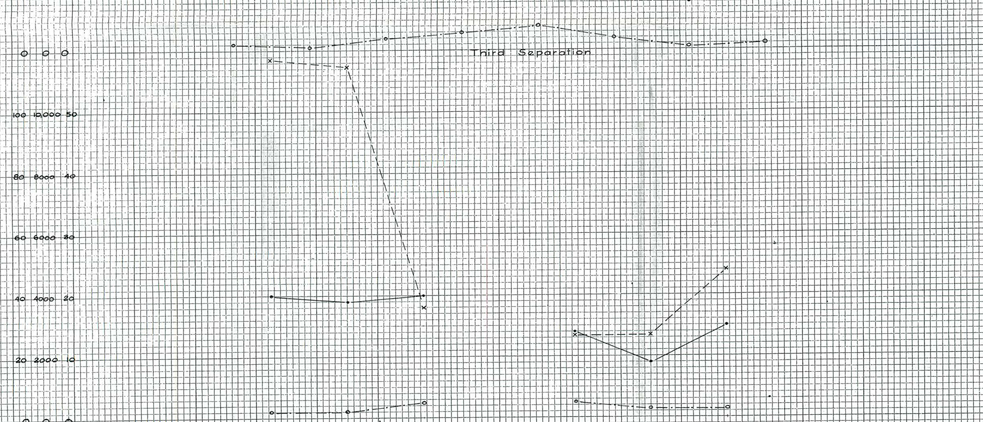


Fourth Separation

INDUCED POLARIZATION PROFILES

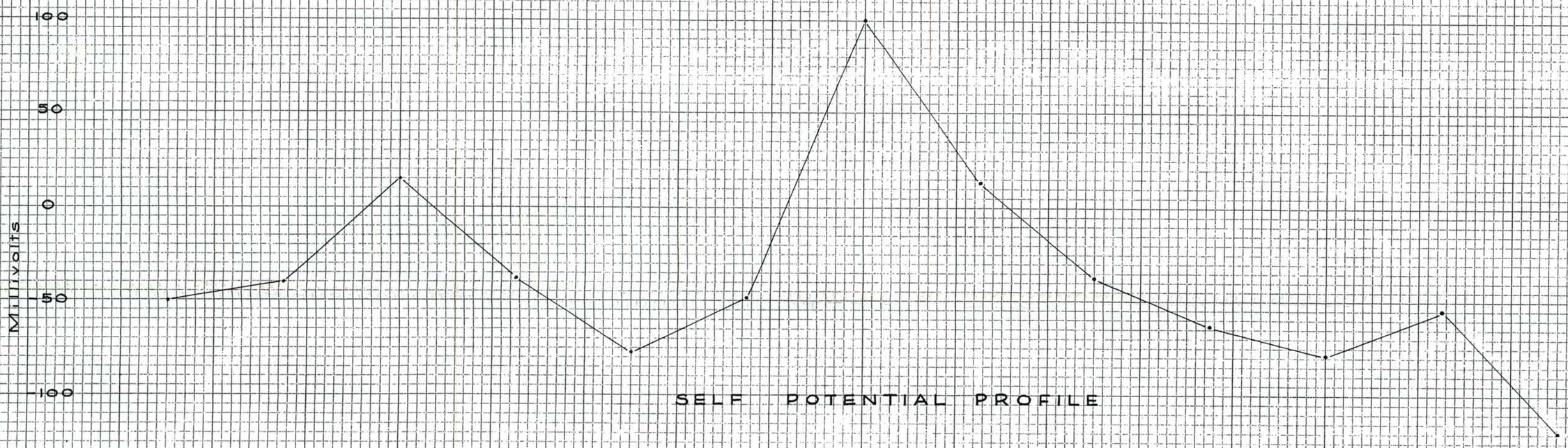
Metallic Conduction Factor
Resistivity, ohm feet/2 π
Percent Frequency Effect

COMPOSITE PROFILES
LINE 3600W - Spread I
ORE KNOB PROJECT
October 1962 Scale: 1" = 400'

35N 30N 25N 20N 15N 10N 5N 0 5S 10S 15S 20S 25S

Hundreds of feet

Looking East



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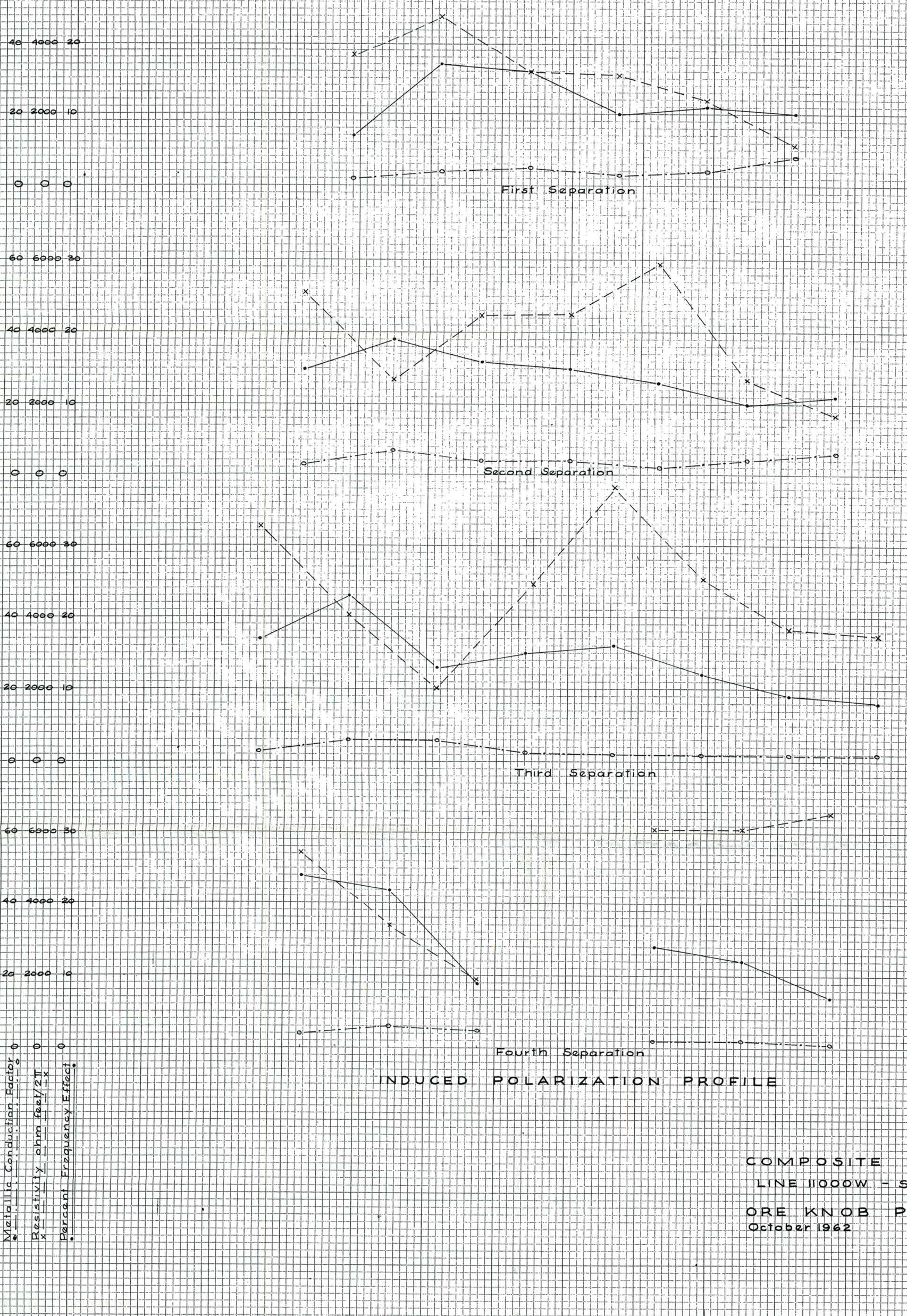


INDUCED POLARIZATION PROFILE

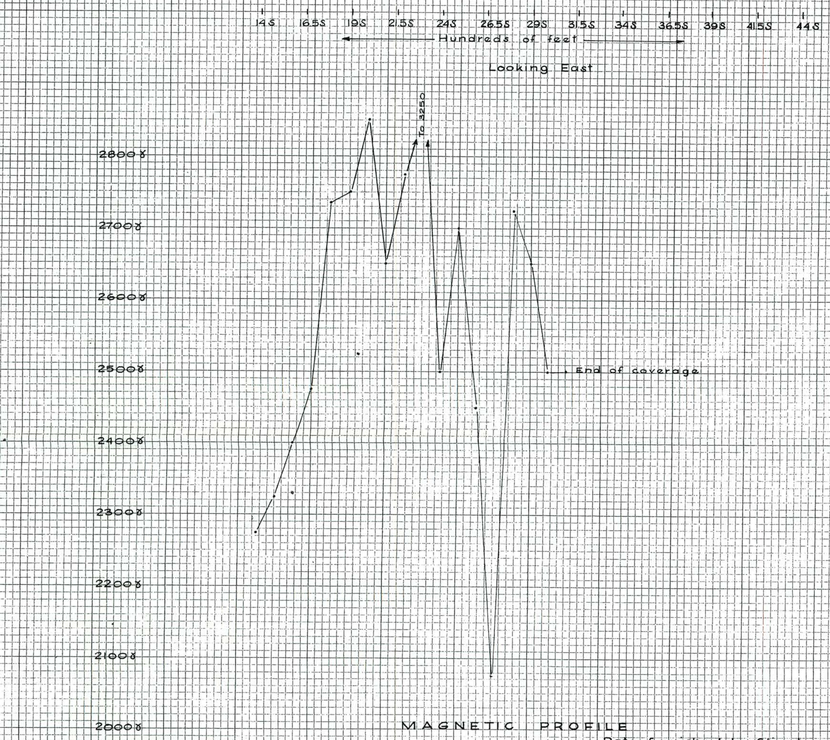
COMPOSITE PROFILES

LINE 11000W - Spread 1

ORE KNOB PROJECT

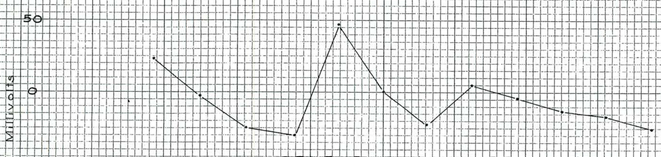
October 1962 Scale: 1"=400'


36N 31N 26N 21N 16N 11N 6N 1N 4S 9S 14S 19S 24S 29S 34S 39S 44S 49S 54S 59S
Hundreds of feet
Looking East
End of coverage
MAGNETIC PROFILE
Data furnished by Client
Millivolts
SELF POTENTIAL PROFILE
First Separation
Second Separation
Third Separation
Fourth Separation
INDUCED POLARIZATION PROFILES
Spread 1
Spread 2
Metallic Conduction Factor
Resistivity ohm feet/2π
Percent Frequency Effect
COMPOSITE PROFILES
LINE 2000W - Spreads 1 & 2
ORE KNOB PROJECT
October 1962
Scale: 1" = 400'

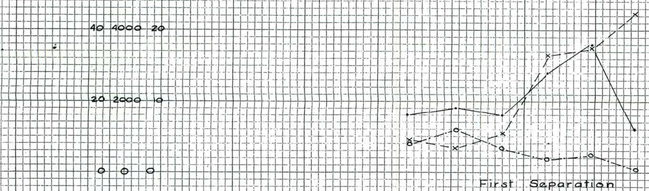


MAGNETIC PROFILE

Data furnished by Client



SELF POTENTIAL PROFILE



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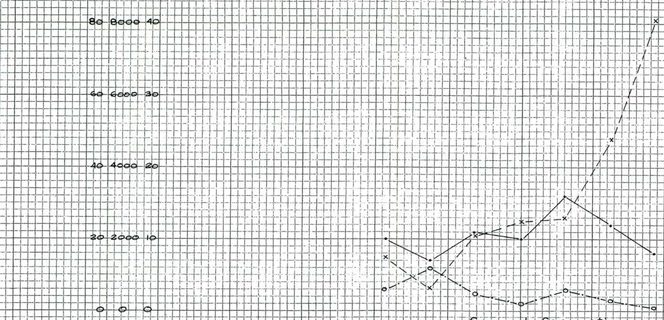

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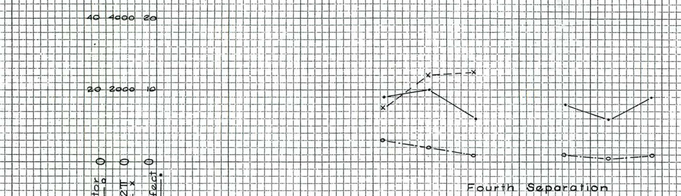
Third Separation



Fourth Separation

INDUCED POLARIZATION PROFILES

COMPOSITE PROFILES

LINE 2000W - Spread 2

ORE KNOB PROJECT

October 1962 Scale: 1"=400'

K&E STANDARD ®
KEUFFEL & ESSER CO. MADE IN THE U.S.A.

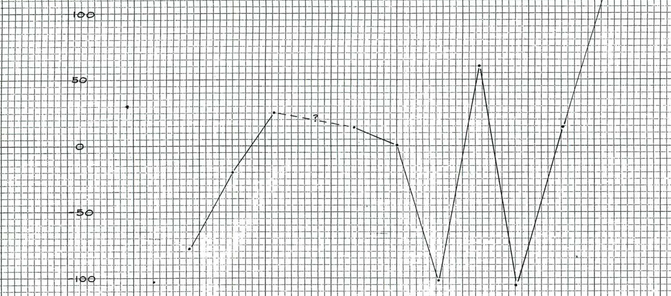
21N 18SN 16N 13SN 11N 8SN 6N 3SN 1ON 1SS 4S 6SS 9S

Hundreds of feet

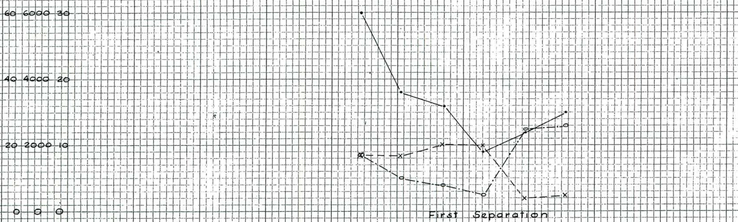
Looking East

MAGNETIC PROFILE

Data furnished by Client



SELF POTENTIAL PROFILE



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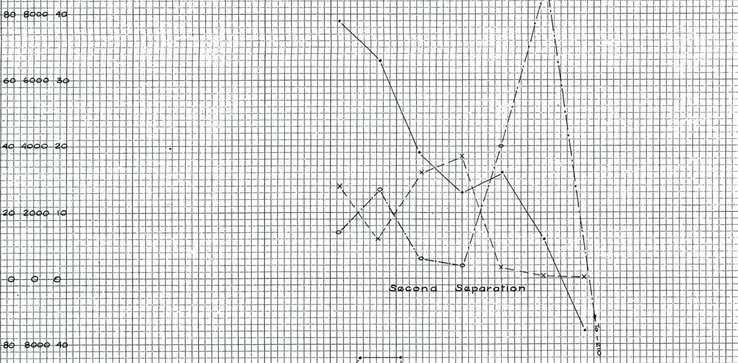

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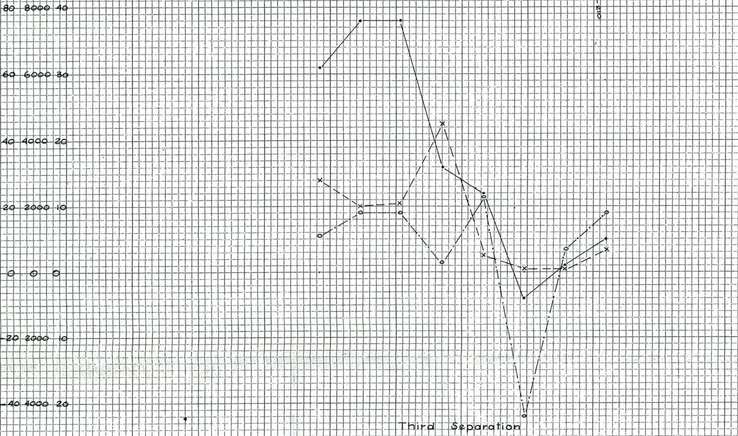

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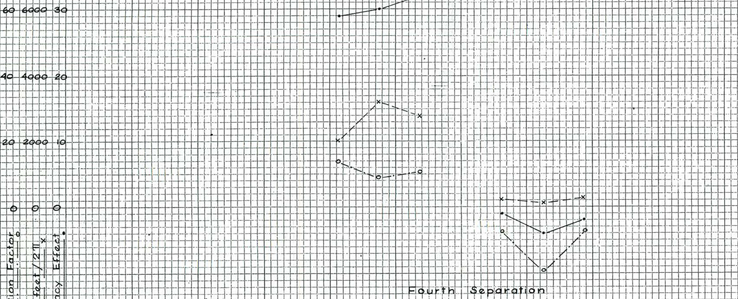


Fourth Separation

INDUCED POLARIZATION PROFILES

Metallic Conduction Factor
Resistivity ohm feet / 2 π
Percent Frequency Effect

COMPOSITE PROFILES

LINE 2000W - Spread I

ORE KNOB PROJECT

October 1962 Scale 1"=400'

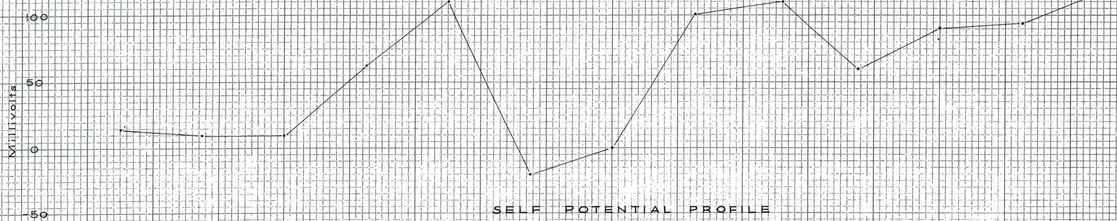
20N 15N 10N 5N 0 5S 10S 15S 20S 25S 30S

Hundreds of feet

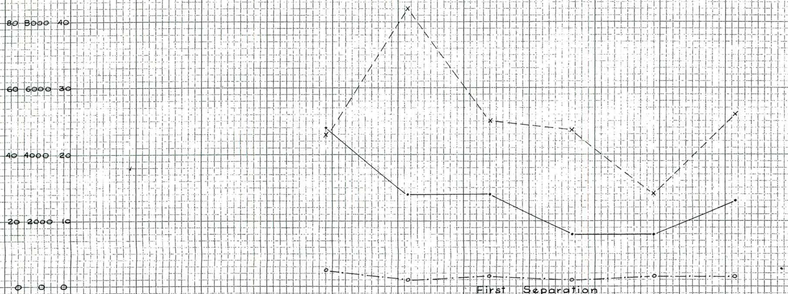
Looking East

MAGNETIC PROFILE

Data furnished by Client



SELF POTENTIAL PROFILE



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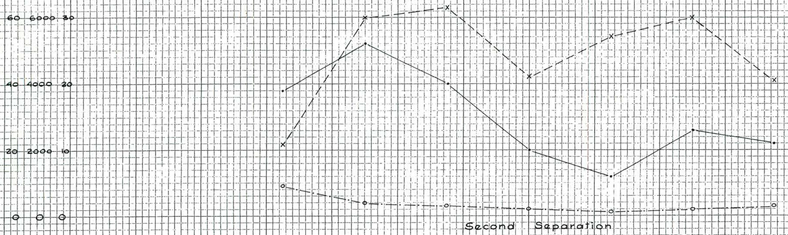
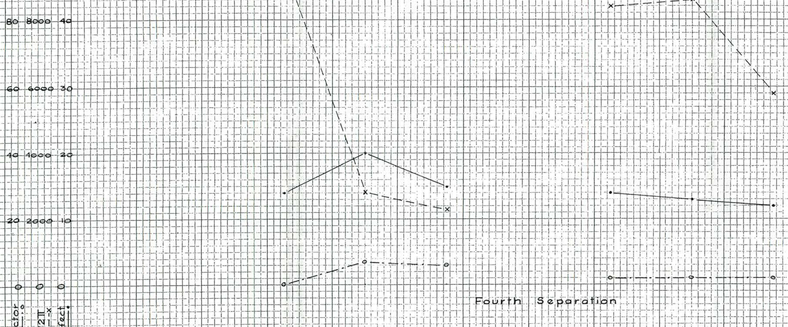


Second Separation

Third Separation



Fourth Separation

Metallic Conduction Factor ——.0
Resistivity ohm feet /2π ——x
Percent Frequency Effect ——x

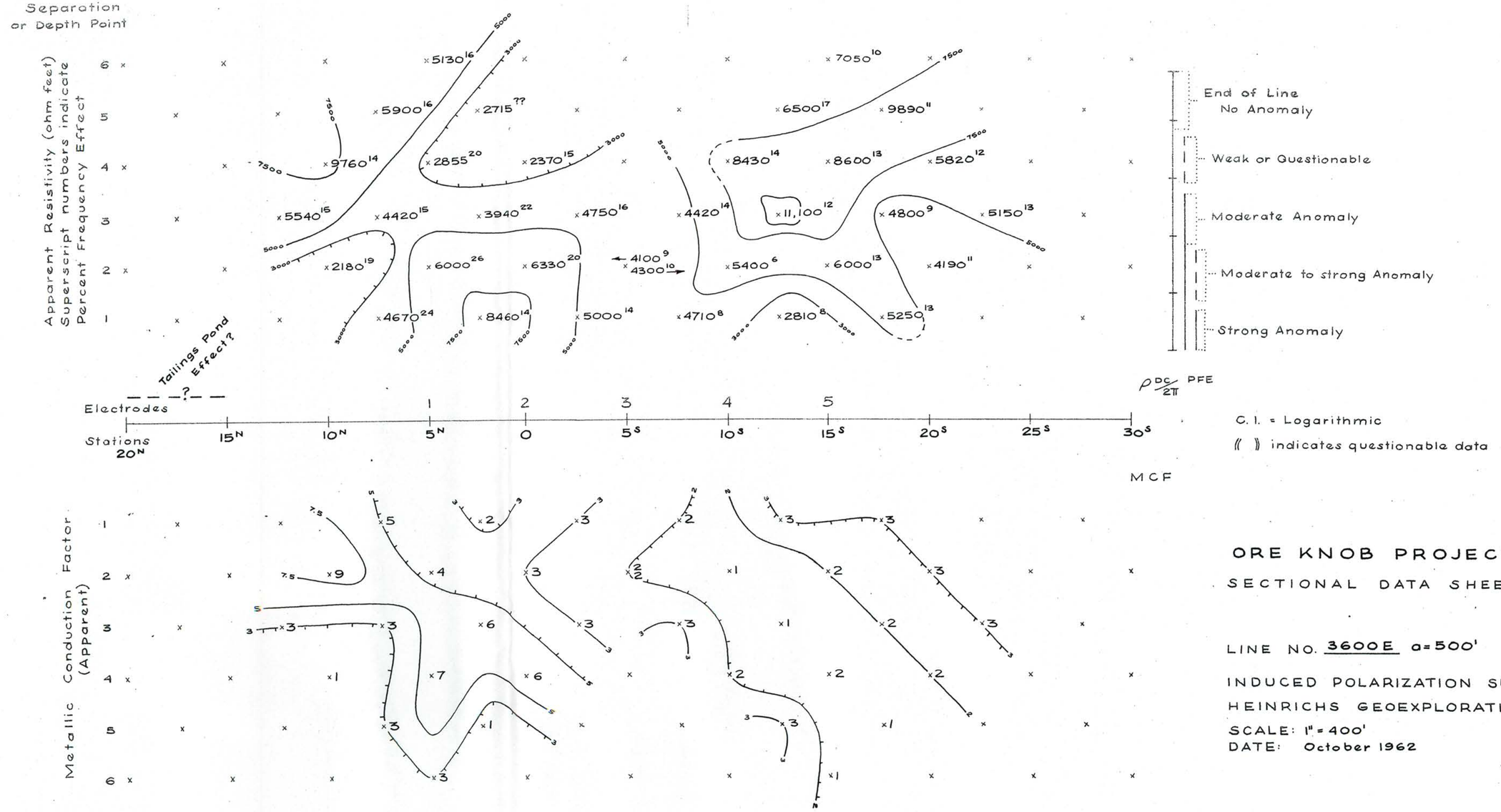
INDUCED POLARIZATION PROFILES

COMPOSITE PROFILES

LINE 3600E - Spread I

ORE KNOB PROJECT

October 1962 Scale 1"=400'



ORE KNOB PROJECT

SECTIONAL DATA SHEET

LINE NO. 3600E a=500'

INDUCED POLARIZATION SURVEY

HEINRICHS GEOEXPLORATION CO.

SCALE: 1" = 400'

DATE: October 1962

Geophysical Investigations at Ore Knob Mine and Vicinity

GEOPHYSICAL INVESTIGATIONS

at the

ORE KNOB MINE AND VICINITY
Ashe County, North Carolina

for

COPPER RANGE COMPANY
White Pine, Michigan

November 1962

by
HEINRICHS GEOEXPLORATION COMPANY
P. O. Box 5671 Tucson, Arizona

TABLE OF CONTENTS

INTRODUCTION

During the month of October 1962, Heinrichs Geoexploration Company conducted induced polarization, resistivity, spontaneous polarization and magnetic surveys at the Ore Knob Mine in Ashe County, North Carolina and reviewed existing electromagnetic, magnetic and spontaneous polarization data. GEOEX personnel involved in the field work were E. G. Heinrichs, F. A. Seward, Jr., and F. F. Hanly with W. E. Heinrichs, Jr. consulting and J. W. Marlatt and C. S. Ludwig assisting in the data review.

Working conditions were technically favorable with no lost time, although the production rate was somewhat less than initial expectations due to a little heavy rain, heavy undergrowth and moderately rugged topography. From a physical property standpoint the area is considered an ideal province for geophysical investigation, particularly by electrical methods.

CONCLUSIONS AND RECOMMENDATIONS

1. Induced polarization and resistivity data over the Ore Knob ore body gave excellent and conclusive results.

2. The existing self potential data, largely confirmed by additional field work by GEOEX, very effectively outlines the limits of the ore body.

3. The previous Sharpe S.E. 200 electromagnetic survey seems to have indicated the ore zone, at least in part, but neither the method nor particular technique used appears to be the optimum application.

4. Magnetic results, in part confirmed by additional field work by GEOEX, does not reveal strong surface anomalism directly assigned to ore deposition. However, there may still be a weak direct correlation of importance as well as some very significant possible indirect relationships. An example of the latter is the long broad high paralleling the mineralized zone in the hanging wall. This is most likely only a regional or rock type feature, but could also be caused by factors either directly or indirectly genetically related to the mineralization. Further conclusions would require additional reconnaissance coverage and study in the area, including some systematic testing of hand samples of ores and country rock for magnetic susceptibility.

5. No geophysical indications approaching in character

or intensity those observed over the known mineralization on Lines 2000 West and 800 West were discovered in the course of the survey over previously unexplored ground. It is therefore concluded that significant additional economic deposition above 1,500 ft. in the ground processed is very unlikely.

6. In regional reconnaissance exploration in this area, self potential, magnetics and perhaps Afmag (audio frequency magnetics), if the latter demonstrates success in certain required experimental local tests, along with geochemical soil sampling and analysis, would be the best, least expensive and most rapid approaches. More detailed follow-up by induced polarization surveying should be made of any anomalies discovered to aid in selecting drill targets.

INDUCED POLARIZATION SURVEYS

Procedures and Objectives: Preliminary tests were made over the Ore Knob ore body to determine optimum electrode spacing and the response that might be expected from any extension or other similar occurrence that might exist in the area.

Line 2000W, Spread #1 was centered at Station 6N and designed to determine the response over the known ore body as well as to test the ground in the vicinity of a mineralized quartz outcrop near Station 18N. Spread #2 was an extension of this line to the south, centered at Station 29S designed to process the hangingwall to about Station 50S and particularly to test the magnetic anomaly centered at Station 23S. This initial work was run in "double density", that is to say, both spreads were run at two different electrode spacings, 500 ft. and 250 ft. This work determined that a 500 ft. dipole spacing should be sufficient to discover any mineral occurrence of economic significance and that a 250 ft. or perhaps smaller spacing would be required to map in detail any mineralized zones discovered and to plan any drill holes necessary.

Line 800W was centered at Station 10S and designed to test the known ore body and the magnetic anomaly centered at Station 2000S.

Line 3600W was centered at Station 5N and was designed to process the ground at relatively shallow depths above

moderately deep drill information and to confirm said drill hole data.

Line 3600E was centered at Station 5S with the objective of testing the eastern extension of the mineralized trend.

Line 11,000W centered at Station 5N was intended to explore the westward extension of the mineralized trend and to test several E.M. crossovers previously observed.

INTERPRETATION

On Line 2000W, excellent response was obtained over the ore body on Spread #1 of the 500 ft. dipoles. Strongest effects were observed between Station 1N and 4S, moderate effects from 1N to 6N and questionable anomalism from 6N - 16N. This latter interpretation is based on rather high background (?) frequency effects possibly related to weak disseminated sulfides in the country rock in this region, coupled with very high d.c. resistivities. The anomalous region appears to attenuate much more sharply to the north of 6N than to the south and this is interpreted as related to the southerly dip of the vein. Spread #1 of the 250 ft. dipoles in this line again centered at 6N provides even greater definition of the orebody and shows cut-off to be essentially between 1N and 1.5S. There are indications that the results integrate the effects of two separate sources--one located in the immediate region of 1N and the other in the vicinity of 4S. This becomes particularly apparent in the self

potential data. It has been suggested that the effects near 4S are from a known vein in the hangingwall and of no economic importance.

Spread #2 of Line 2000W, 500 ft. dipoles revealed minor questionable anomalism from 19S to 29S and again possibly from 44S to 49S. The 250 ft. spread over this line showed greater contrast particularly between 26.5S and 29S. This feature is interpreted to be one of definite sulfide involvement but narrow and of low grade and not of economic interest. This zone also corresponds to a magnetic low within the high trend but there is no corresponding self potential low.

Line 800S was centered too far south to show the northerly attenuation of the anomaly due to the ore body but the south half of the anomaly which has its principle component between 0 and 5S is almost identical in character with that observed on Line 2000W. There were no other anomalous indications on this line.

Line 3600W showed no significant polarization effects. Minor resistivity contrasts in the region from 0 to 10N and vicinity of 25N are interpreted as being the reflection of the barren structure or host rock.

On Line 3600E only minor questionable polarization was observed between 15N and 20N. The resistivity low and resultant low order metal factor high is tentatively attributed to the

the lateral definition. With this dipole-dipole (Eltran) electrode configuration, the maximum theoretical possible penetration is from 1.0 times the electrode spacing in the first separation to 3.5 times the spacing on the 6th separation. In other words, with theoretically IDEAL conditions of completely isotropic-homogeneous resistivity in every direction both lateral and

SELF POTENTIAL SURVEYS

A review of the self potential surveys performed by Appalachian Sulfides indicated the excellent applicability of this method. Even though it may have been demonstrated by previous work that not all major S. P. lows in the area are ore related, we do believe that almost all shallow ore in the area would give good S. P. response. More or less regional or reconnaissance self potential data is gathered in the normal course of I. P. surveying. In addition several detailed profiles were run to aid in the selection of I. P. line locations.

The profiles over Lines 2000W and 800W clearly indicate the known ore body. A detailed survey of a portion of Line 2000W from 9N to 9S on 100 ft. spacing indicated the twin peaked anomaly mentioned above with one peak at about 1N and the other about 4S to 5S. The second peak was not observed on Line 800W although this could be due to the fact that this line was not run on a detail spacing. The S. P. results on the remainder of the I. P. lines may reflect minor localizations or concentrations of oxidizing sulfides and certain regional highs and lows that may or may not be topographically related, but there do not appear to be any features similar in either magnitude, gradient or character to those on Lines 2000W and 800W. An S.P. detail line run on Line 2800W showed a strong regional S.P. high on the south and associated low to the north.

MAGNETICS

A number of detailed magnetic profiles were run to confirm the existing data and to further investigate any relationships between ore mineralization and magnetic anomalies either positive or negative. In general, the previous magnetic work is accurate. As stated previously, the long, broad, but sharply defined magnetic high paralleling the mineralized structure some 2000 to 4000 ft. south of outcrop, is most likely a regional feature related to a particular rock type. However, the spatial coincidence of highest value magnetic closures within an anomalous area with the same relative strike position as the known ore zone, cannot be totally ignored. Also, the apparently rather high magnetic properties of the ore would bear further detail investigation.

SUMMARY

Induced polarization surveys will give excellent results over mineral occurrences similar to the Ore Knob deposit and environs. Reconnaissance application of the method may be somewhat limited by expense but when other methods can be applied such as is the case in this area with self potential, magnetics and perhaps Afmag, I. P. can and should be used as a detail tool to substantiate anomalies obtained by use of the reconnaissance techniques and aid in the planning of drill holes.

Results from the present work did not locate any immediate extensions to the known Ore Knob deposition.

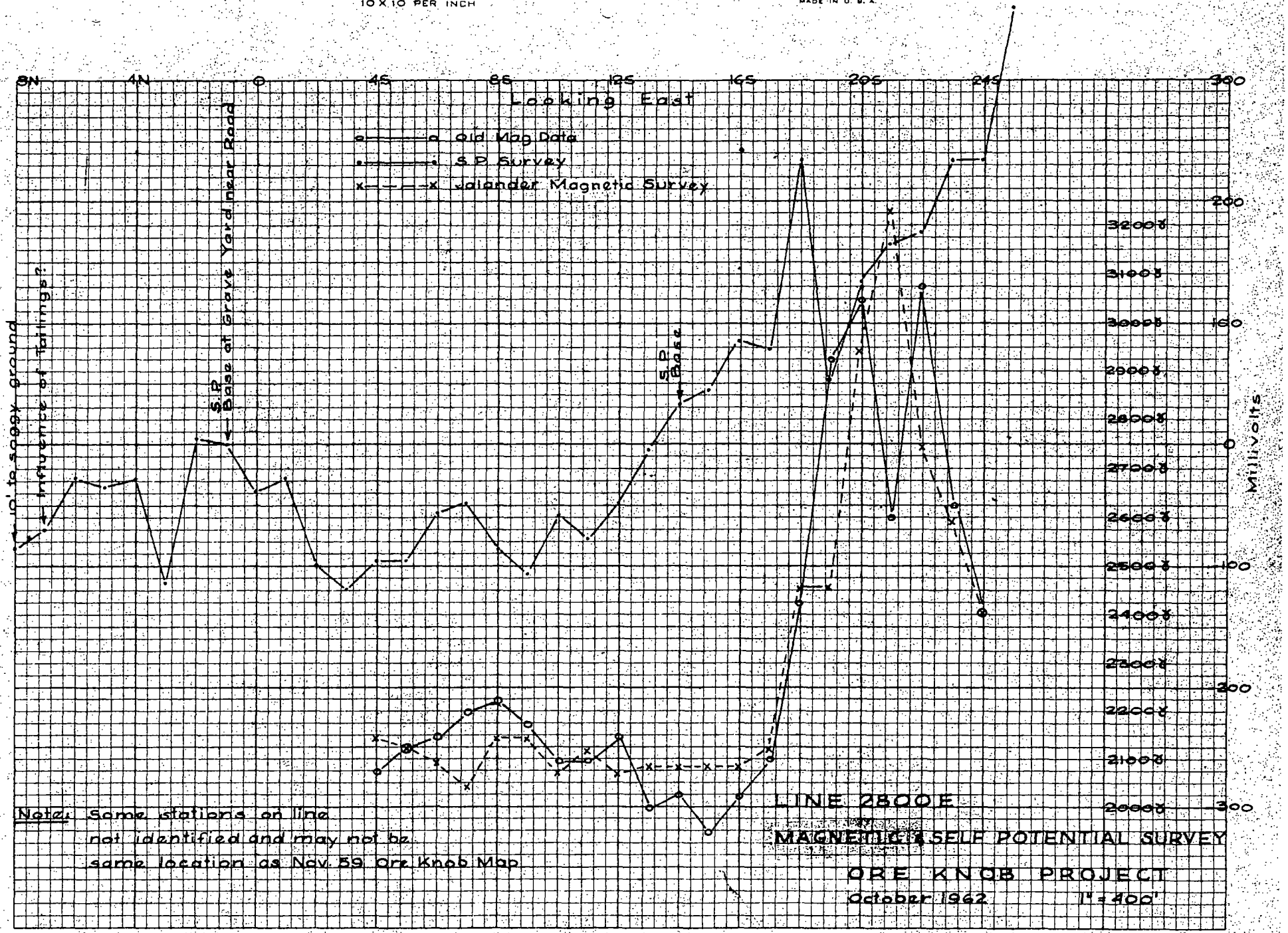
Respectfully submitted,

HEINRICHS GEOEXPLORATION CO.

Franklin A. Seward

Franklin A. Seward, Jr.
Geophysical Engineer

P. O. Box 5671
Tucson, Arizona
November 15, 1962



Note: Some stations on line not identified and may not be same location as Nov 59 Ore Knob Map

LINE 2800E

MAGNETIC & SELF POTENTIAL SURVEY

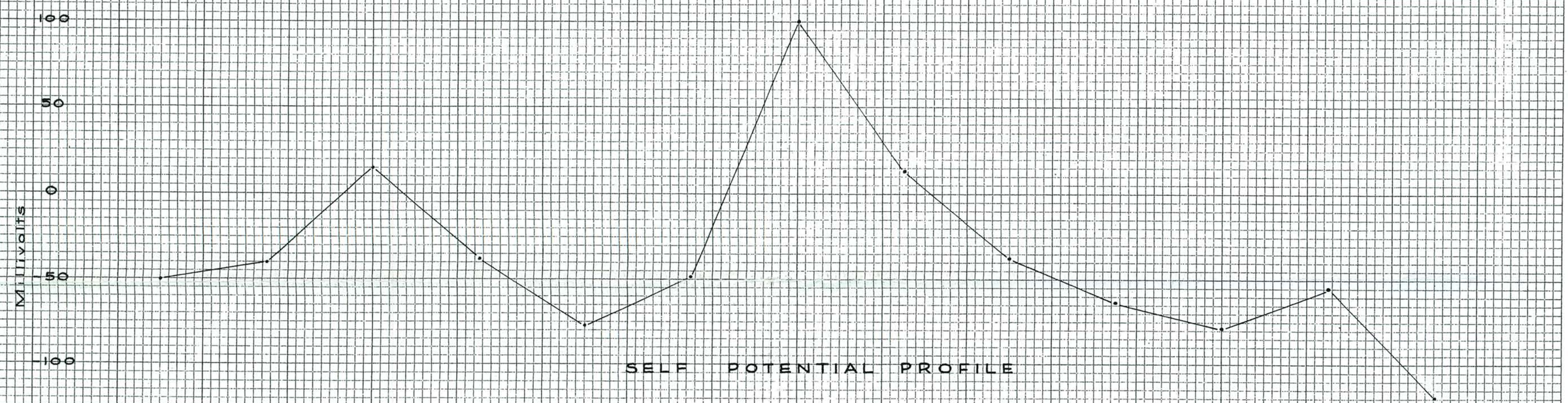
ORE KNOB PROJECT

October 1962 1" = 400'

35N 30N 25N 20N 15N 10N 5N 0 5S 10S 15S 20S 25S

Hundreds of feet

Looking East



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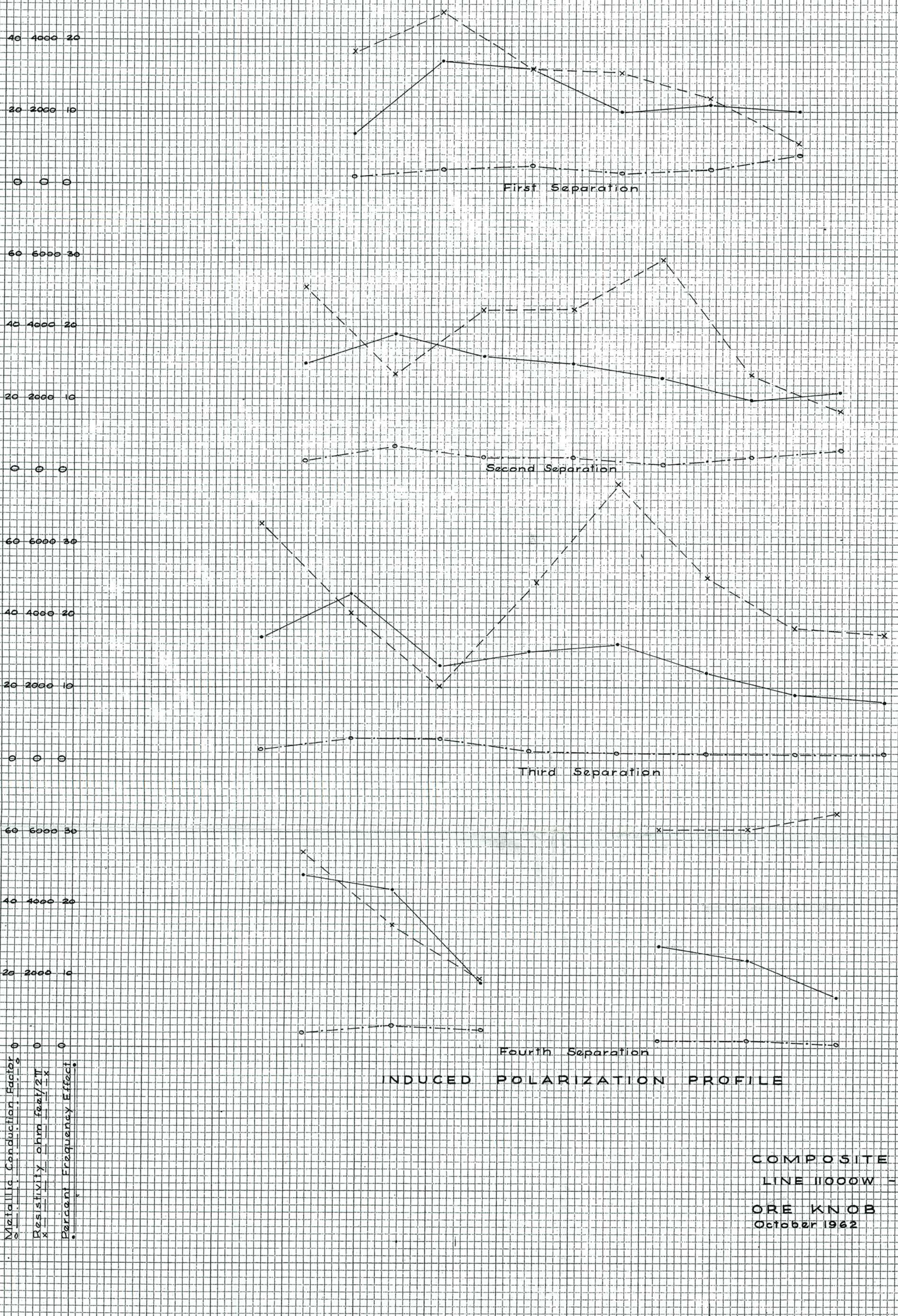


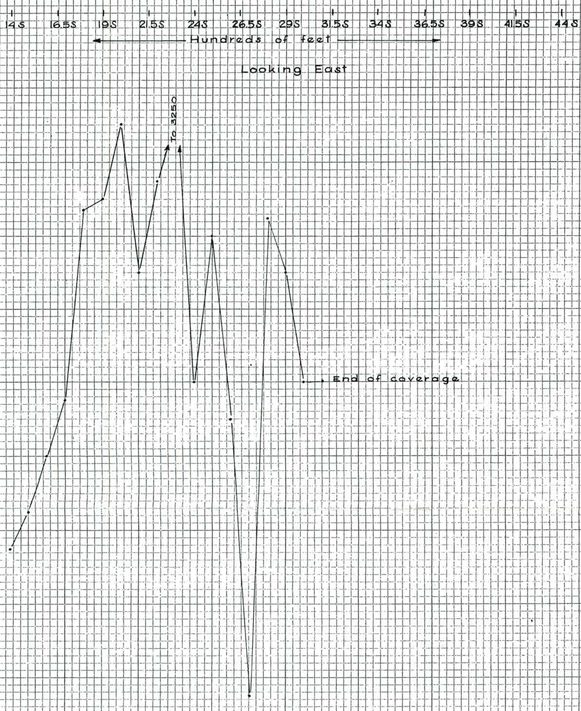
INDUCED POLARIZATION PROFILE

COMPOSITE PROFILES

LINE 11000W - Spread I

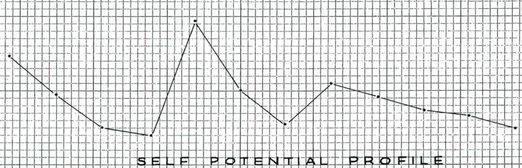
ORE KNOB PROJECT

October 1962 Scale: 1"=400'



MAGNETIC PROFILE

Data furnished by Client



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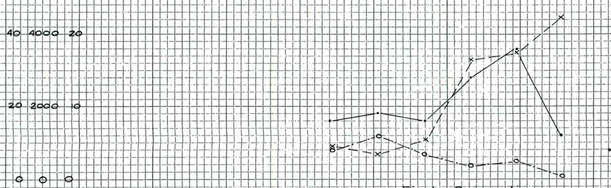
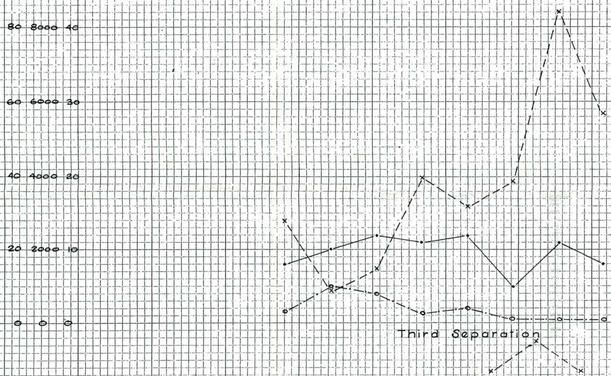
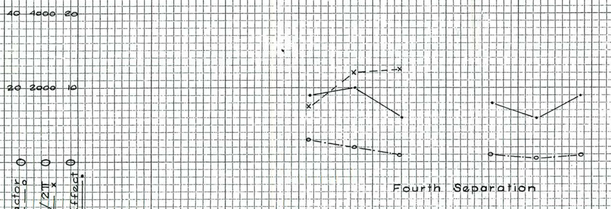


First Separation

Second Separation



Third Separation



Fourth Separation

INDUCED POLARIZATION PROFILES

Metallic Conduction Factor 0
Resistivity ohm feet/2π x 0
Percent Frequency Effect 0

COMPOSITE PROFILES

LINE 2000W - Spread 2

ORE KNOB PROJECT

October 1962 Scale: 1"=400'

K&E STANDARD ® 10 X 10 TO THE INCH

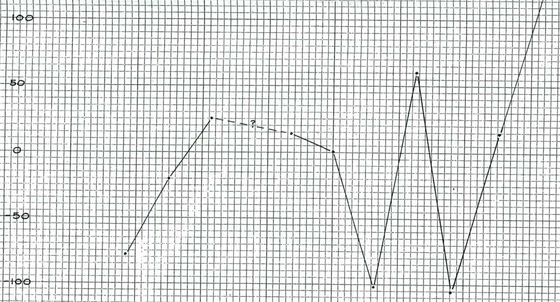
2IN 18.5N 16N 13.5N 11N 8.5N 6N 3.5N 1ON 1.5S 4S 6.5S 9S

Hundreds of feet

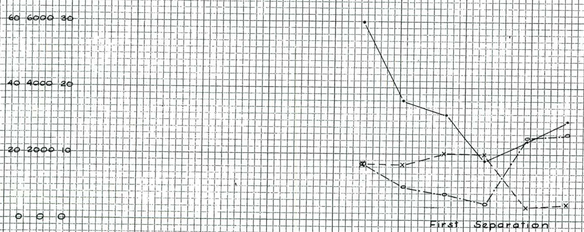
Looking East

MAGNETIC PROFILE

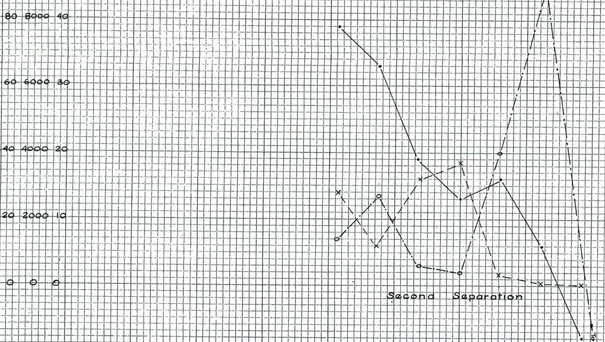
Data furnished by Client



SELF POTENTIAL PROFILE

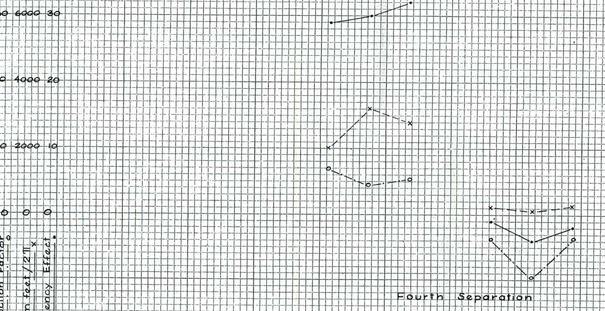


First Separation



Second Separation

Third Separation



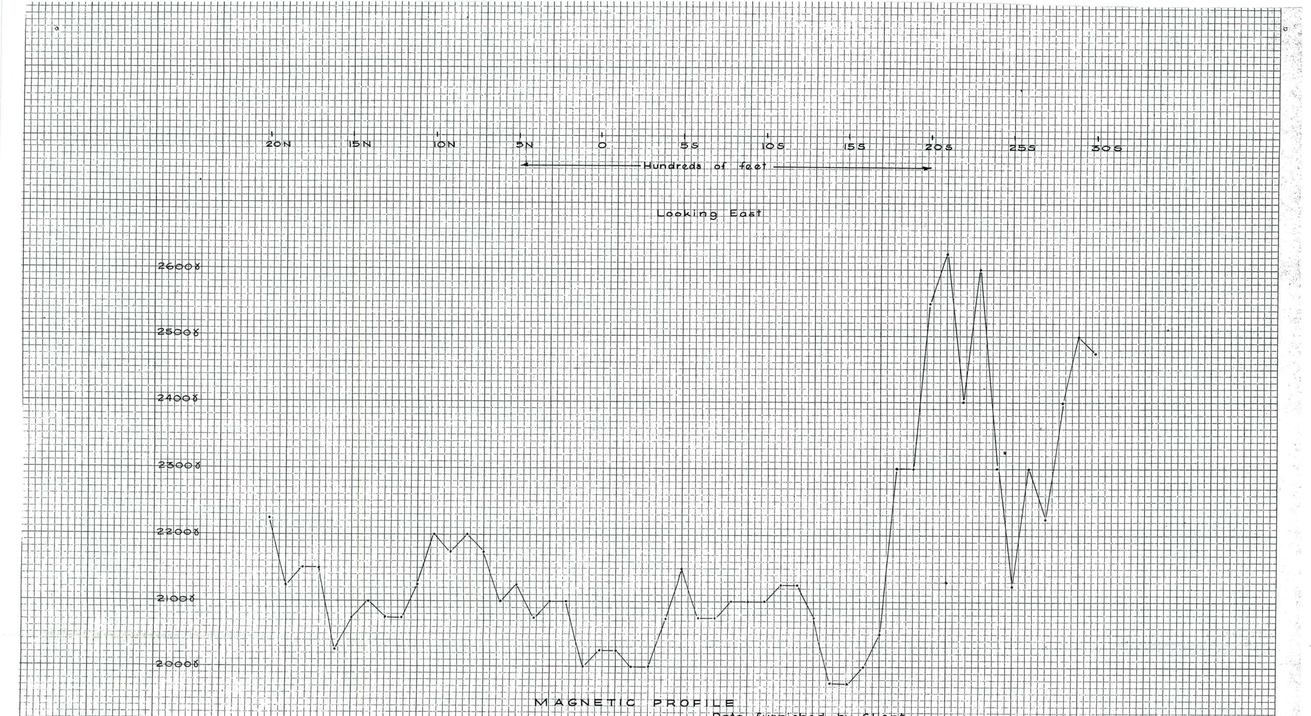
Fourth Separation

INDUCED POLARIZATION PROFILES

Metallic Conduction Factor
Resistivity ohm.feet / 2π
Percent Frequency Effect

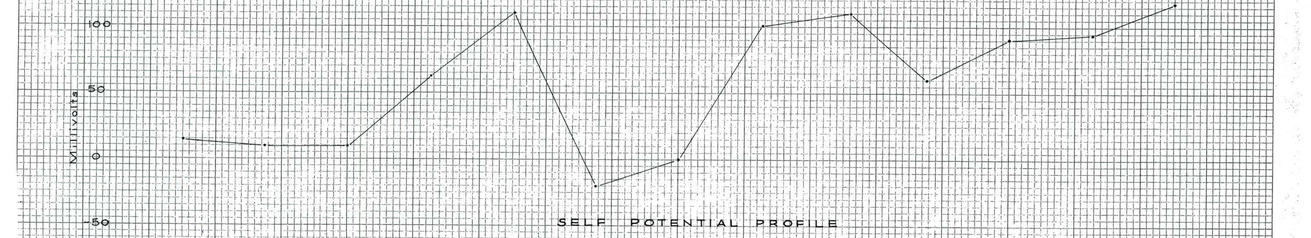
COMPOSITE PROFILES
LINE 2000W - Spread I

ORE KNOB PROJECT
October 1962 Scale 1"=400'

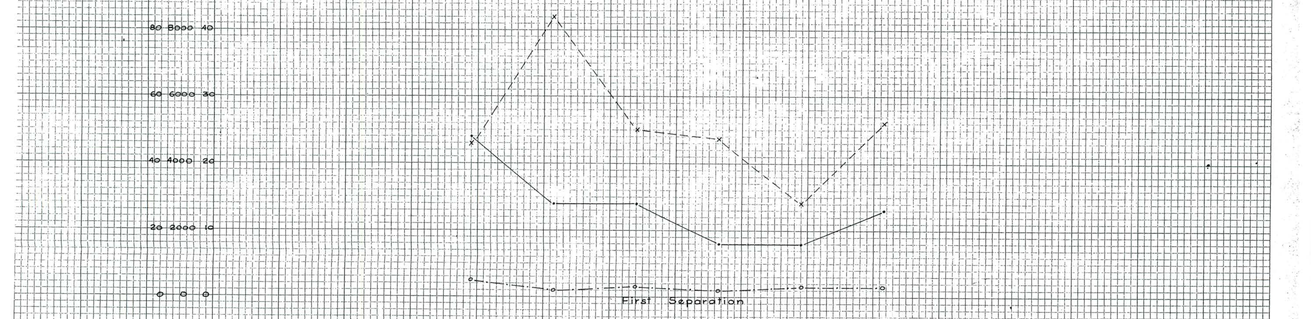


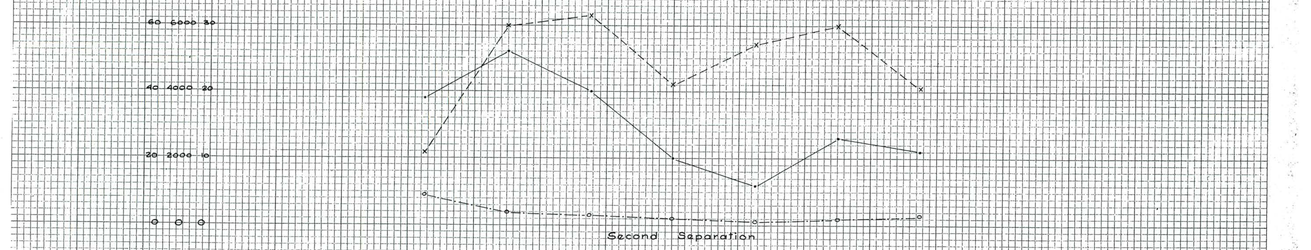
MAGNETIC PROFILE

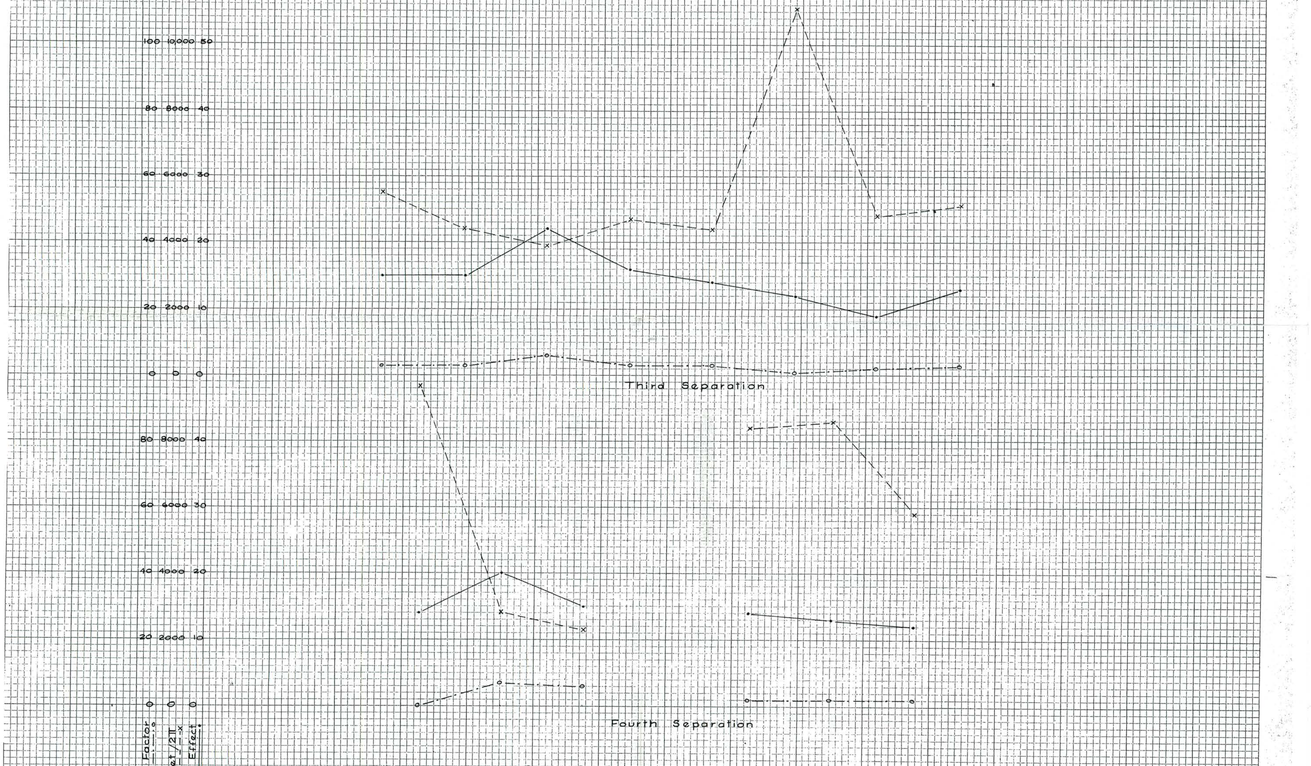
Data furnished by Client



SELF POTENTIAL PROFILE







INDUCED POLARIZATION PROFILES

Metallic Conduction Factor
Resistivity Ohm feet/2π
Percent Frequency Effect

COMPOSITE PROFILES

LINE 3600E - Spread I

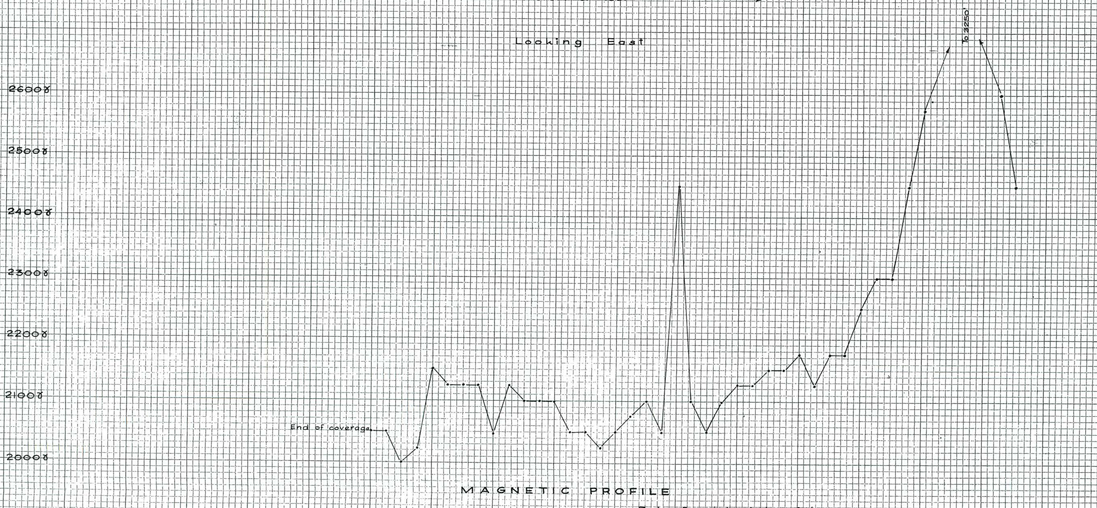
ORE KNOB PROJECT

October 1962 Scale: 1"=400'

Station No. 35N 30N 25N 20N 15N 10N 5N 0 5S 10S 15S 20S 25S

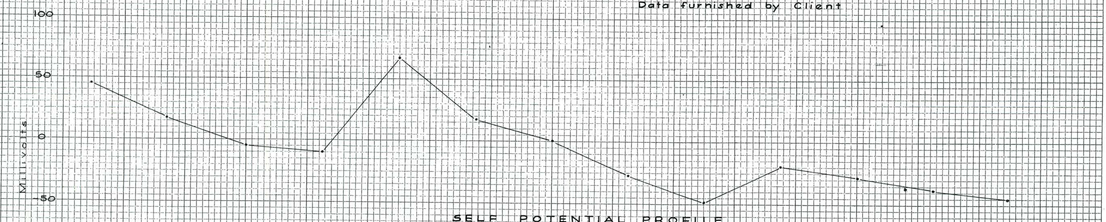
Hundreds of feet

Looking East

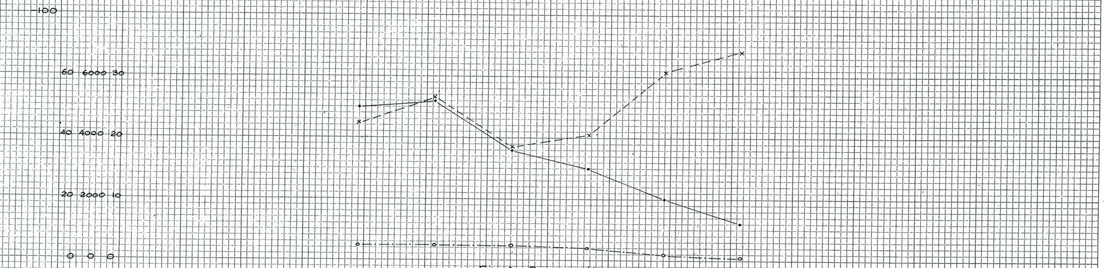


MAGNETIC PROFILE

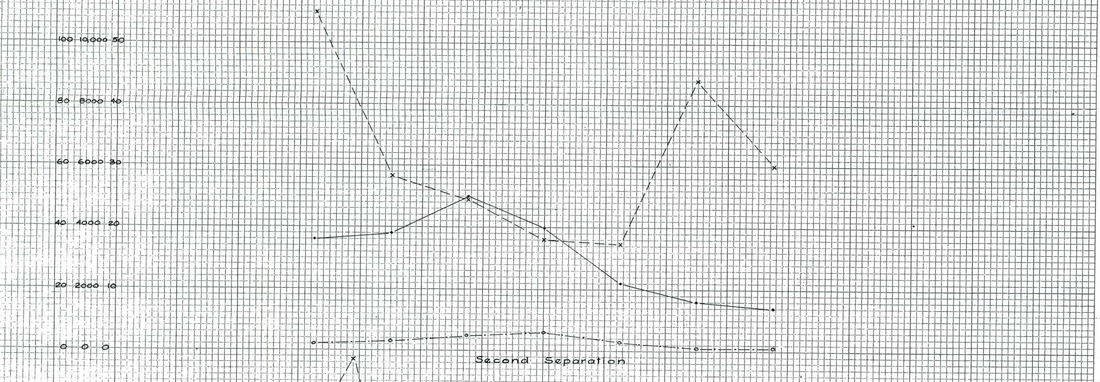
Data furnished by Client



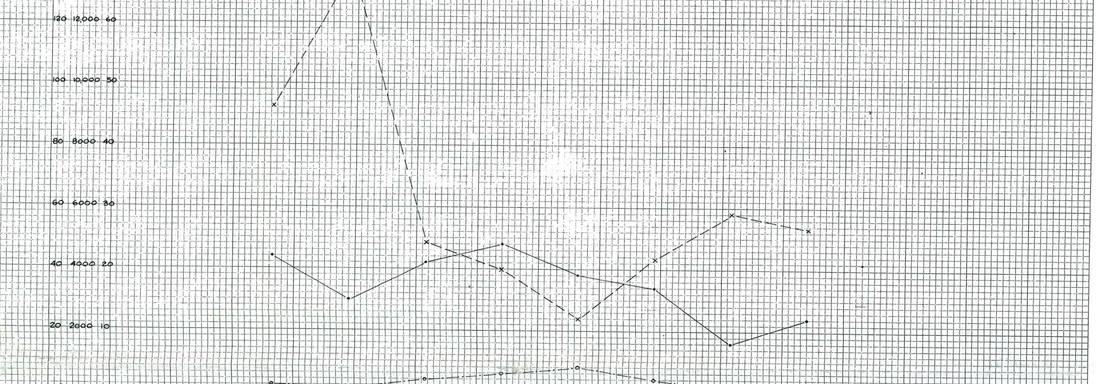
SELF POTENTIAL PROFILE



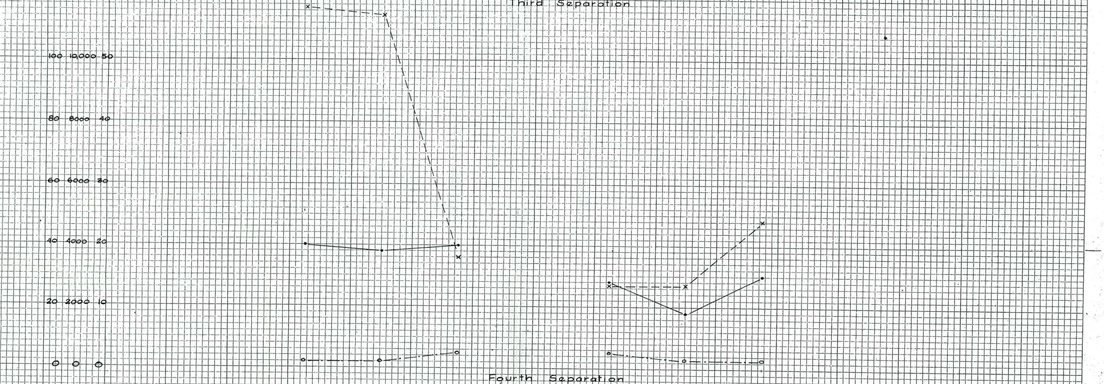
First Separation



Second Separation



Third Separation



Fourth Separation

INDUCED POLARIZATION PROFILES

Metallic Conduction Factor
Resistivity, ohm feet x 2π
Percent Frequency Effect

COMPOSITE PROFILES

LINE 3600W - Spread I

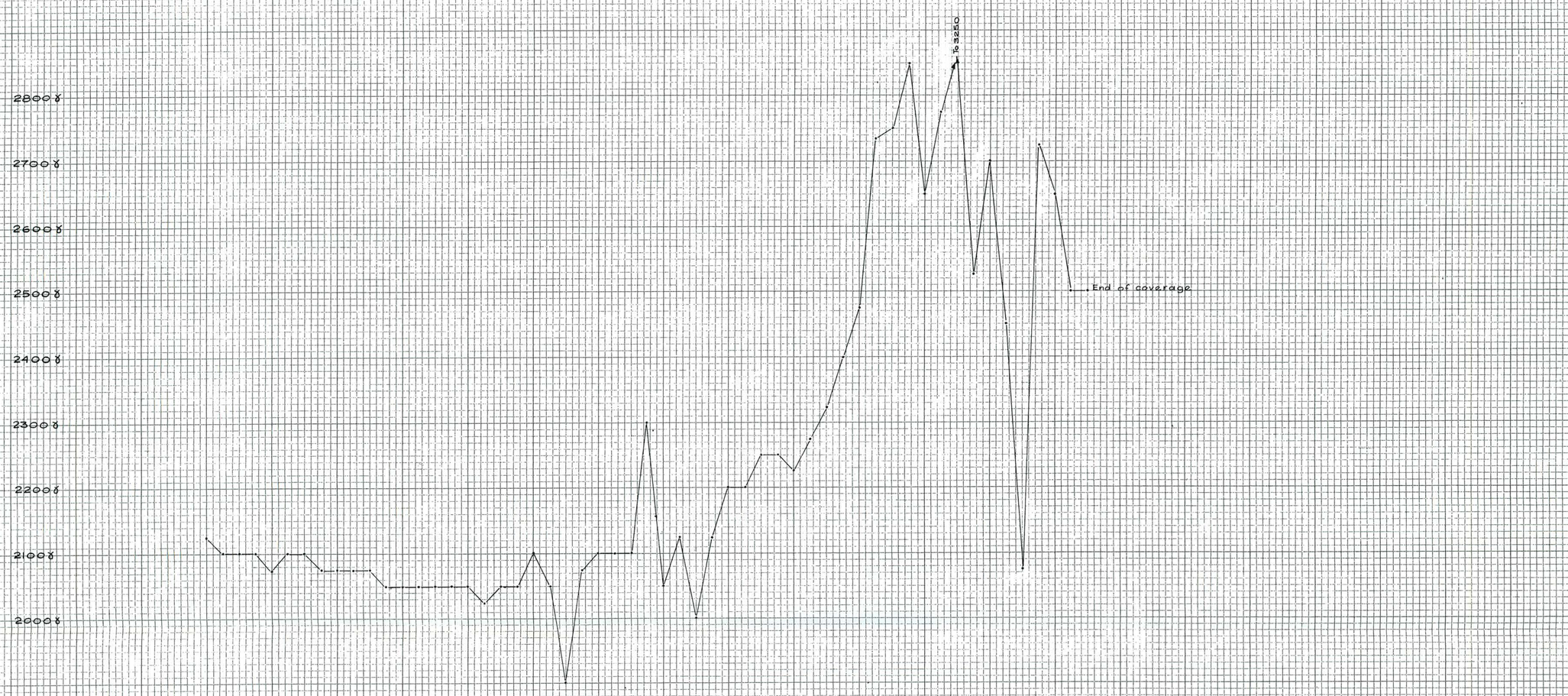
ORE KNOB PROJECT

October 1962 Scale 1" = 400'

36N 31N 26N 21N 16N 11N 6N 1N 4S 9S 14S 19S 24S 29S 34S 39S 44S 49S 54S 59S

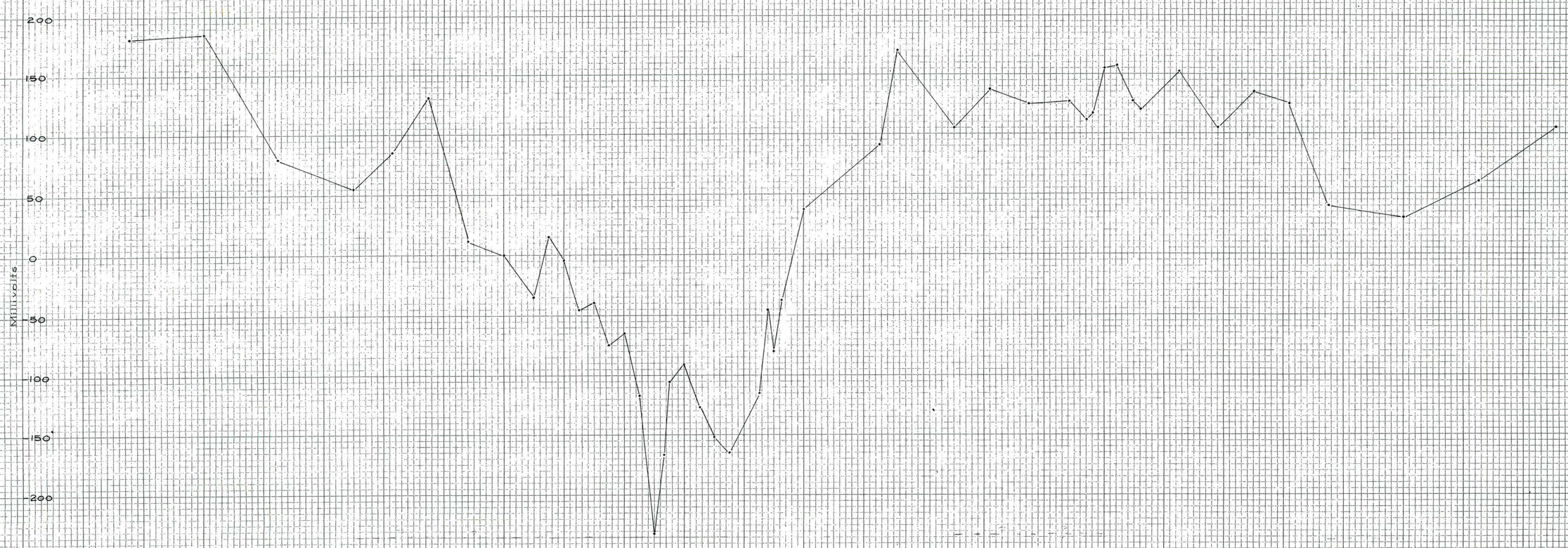
Hundreds of feet

Looking East

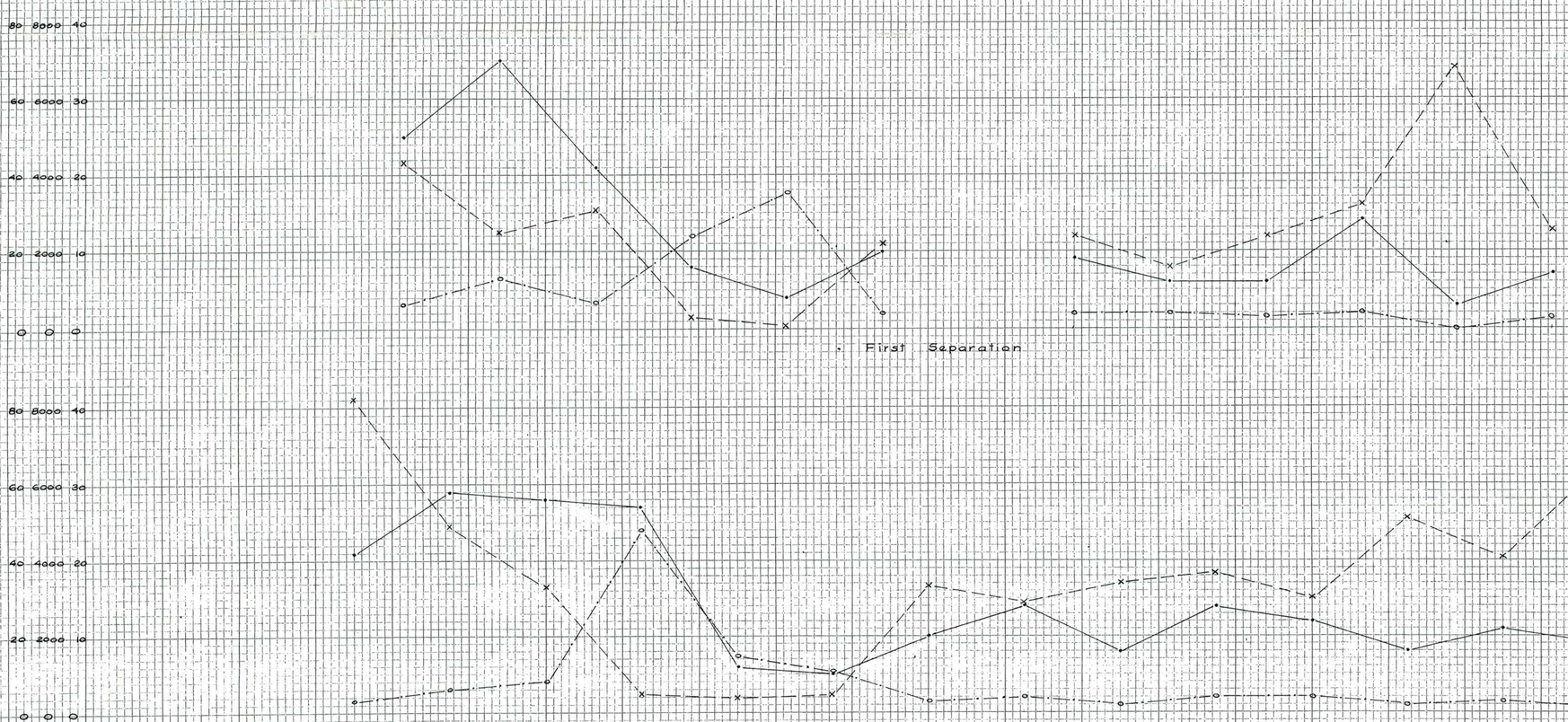


MAGNETIC PROFILE

Data furnished by Client

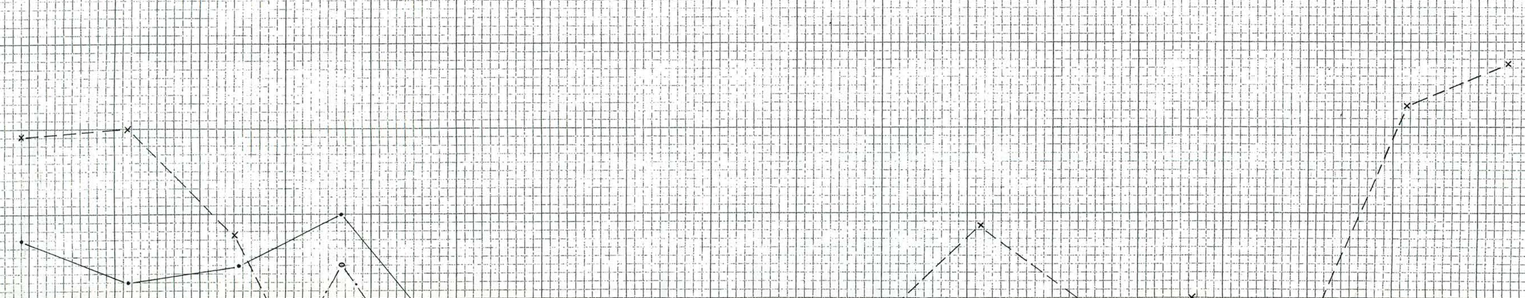


SELF POTENTIAL PROFILE

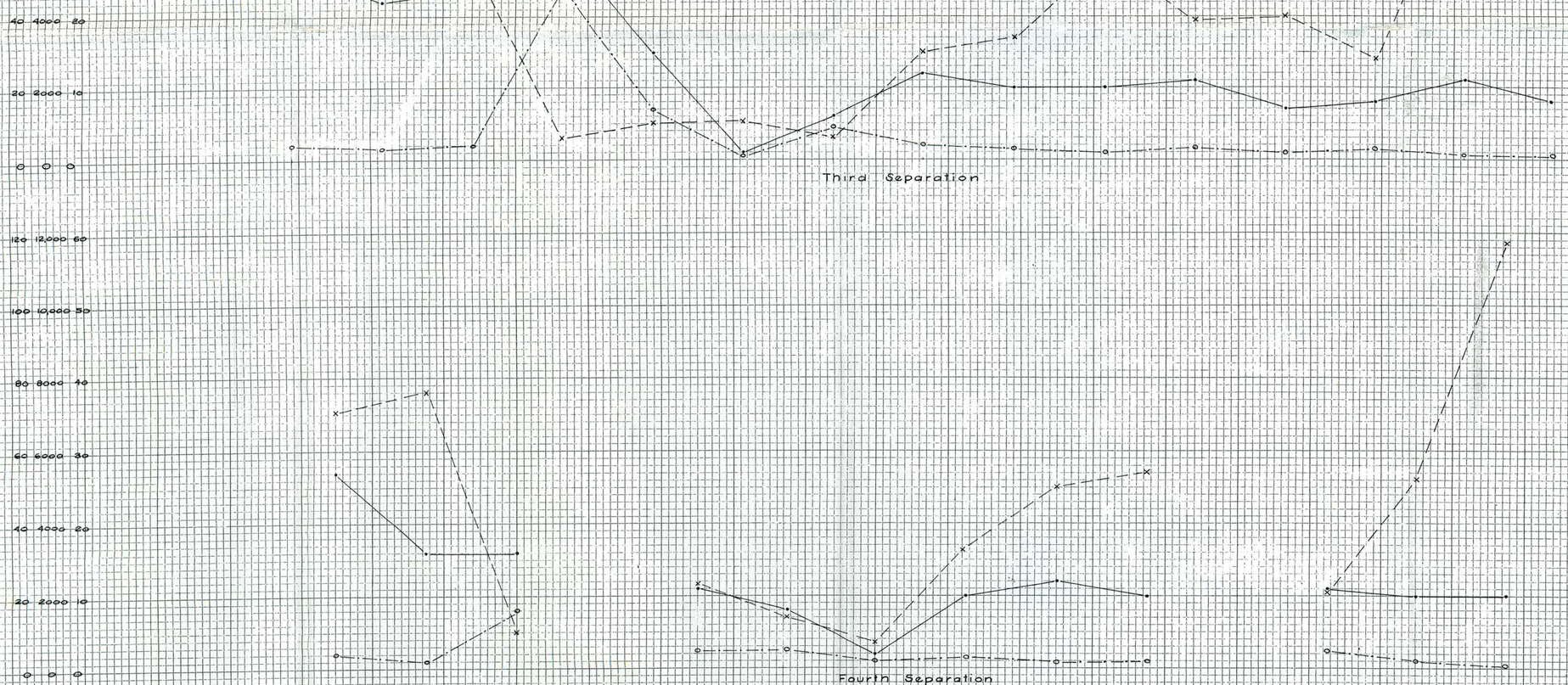


First Separation

Second Separation



Third Separation



Fourth Separation

INDUCED POLARIZATION PROFILES

Spread 1

Spread 2

COMPOSITE PROFILES

LINE 2000W - Spreads 1 & 2

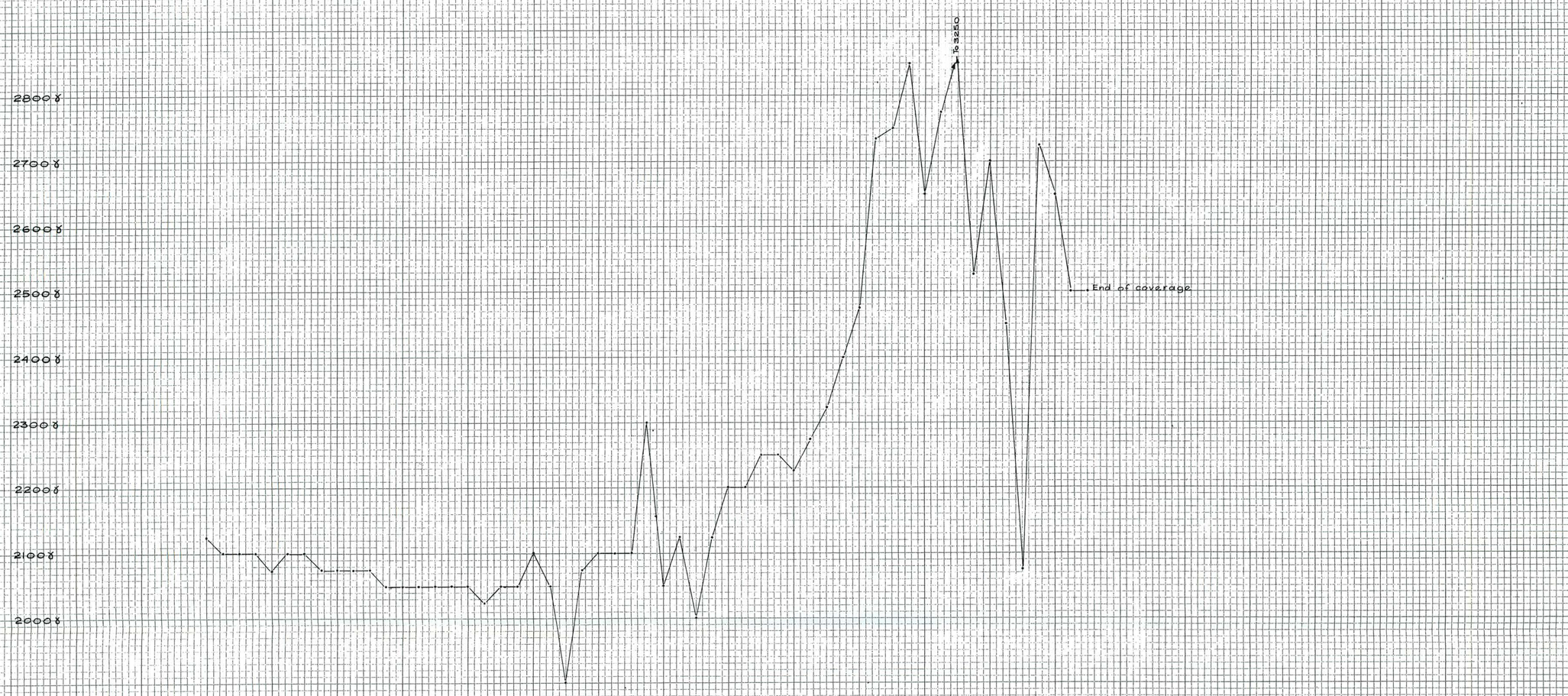
ORE KNOB PROJECT

October 1962 Scale 1"=400'

36N 31N 26N 21N 16N 11N 6N 1N 4S 9S 14S 19S 24S 29S 34S 39S 44S 49S 54S 59S

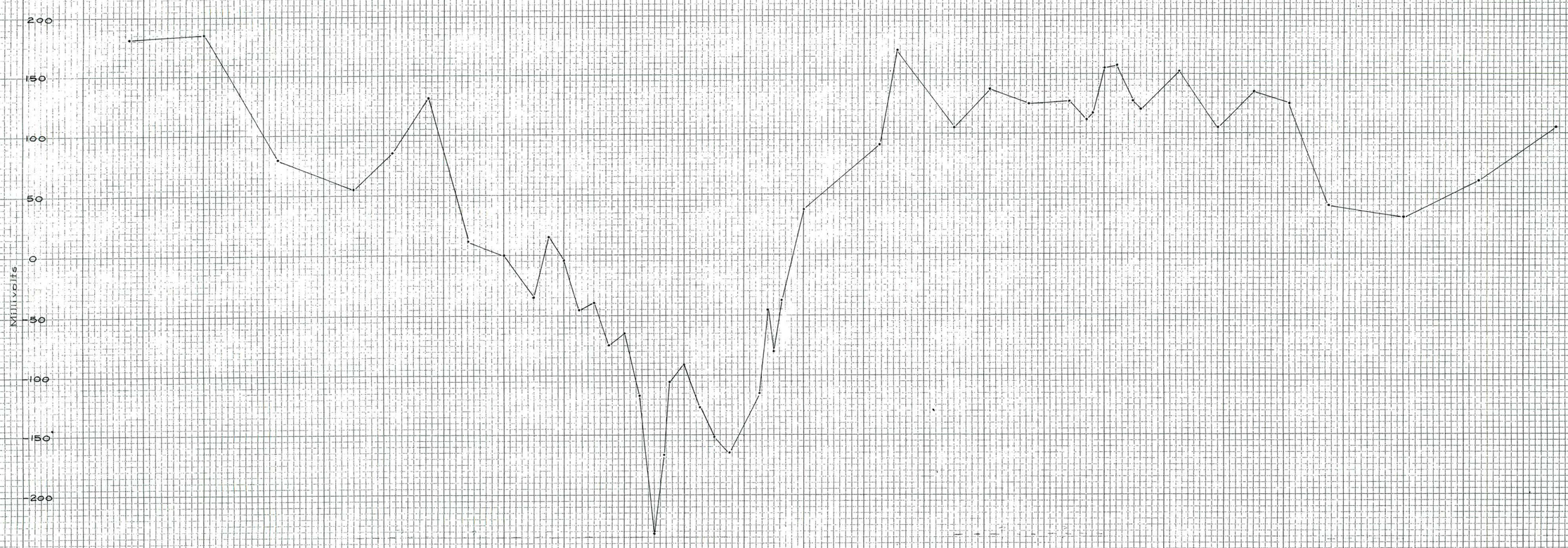
Hundreds of feet

Looking East

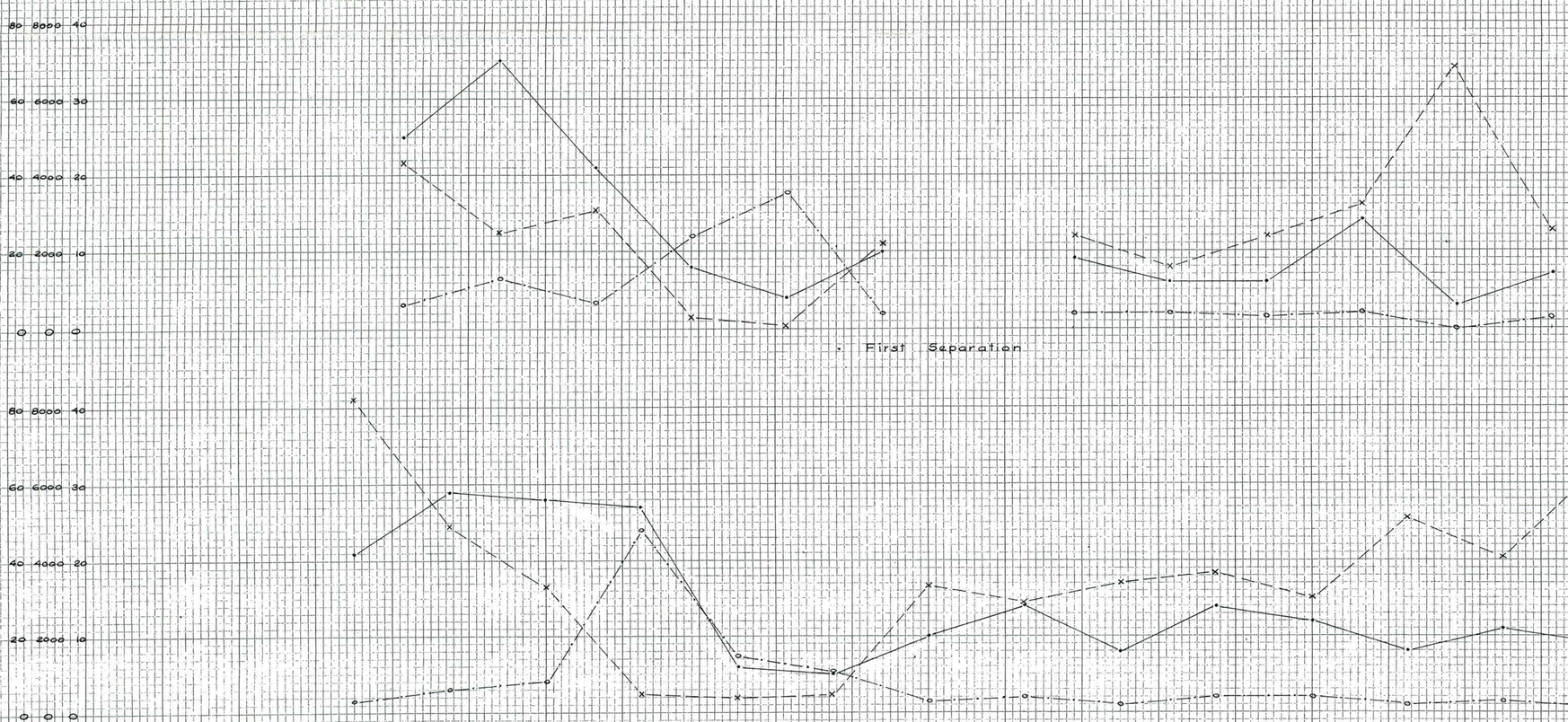


MAGNETIC PROFILE

Data furnished by Client

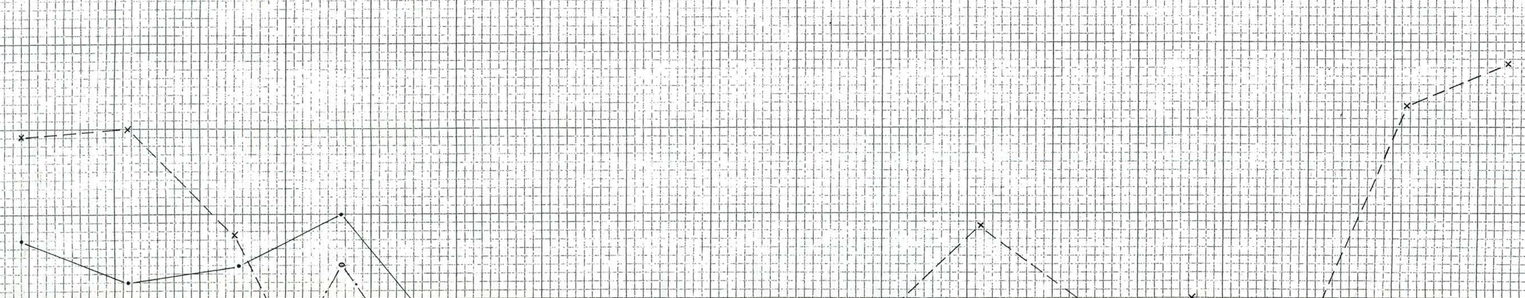


SELF POTENTIAL PROFILE

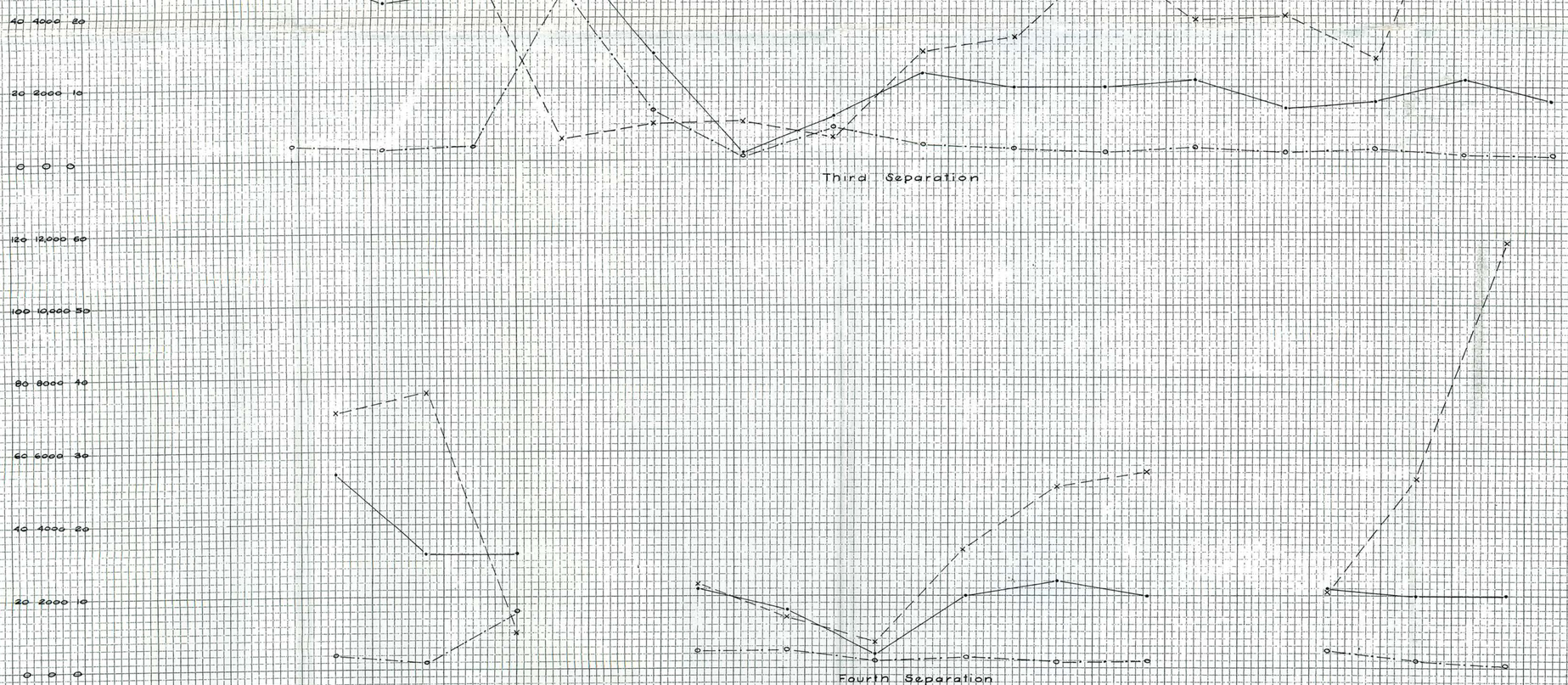


First Separation

Second Separation



Third Separation



Fourth Separation

INDUCED POLARIZATION PROFILES

Spread 1

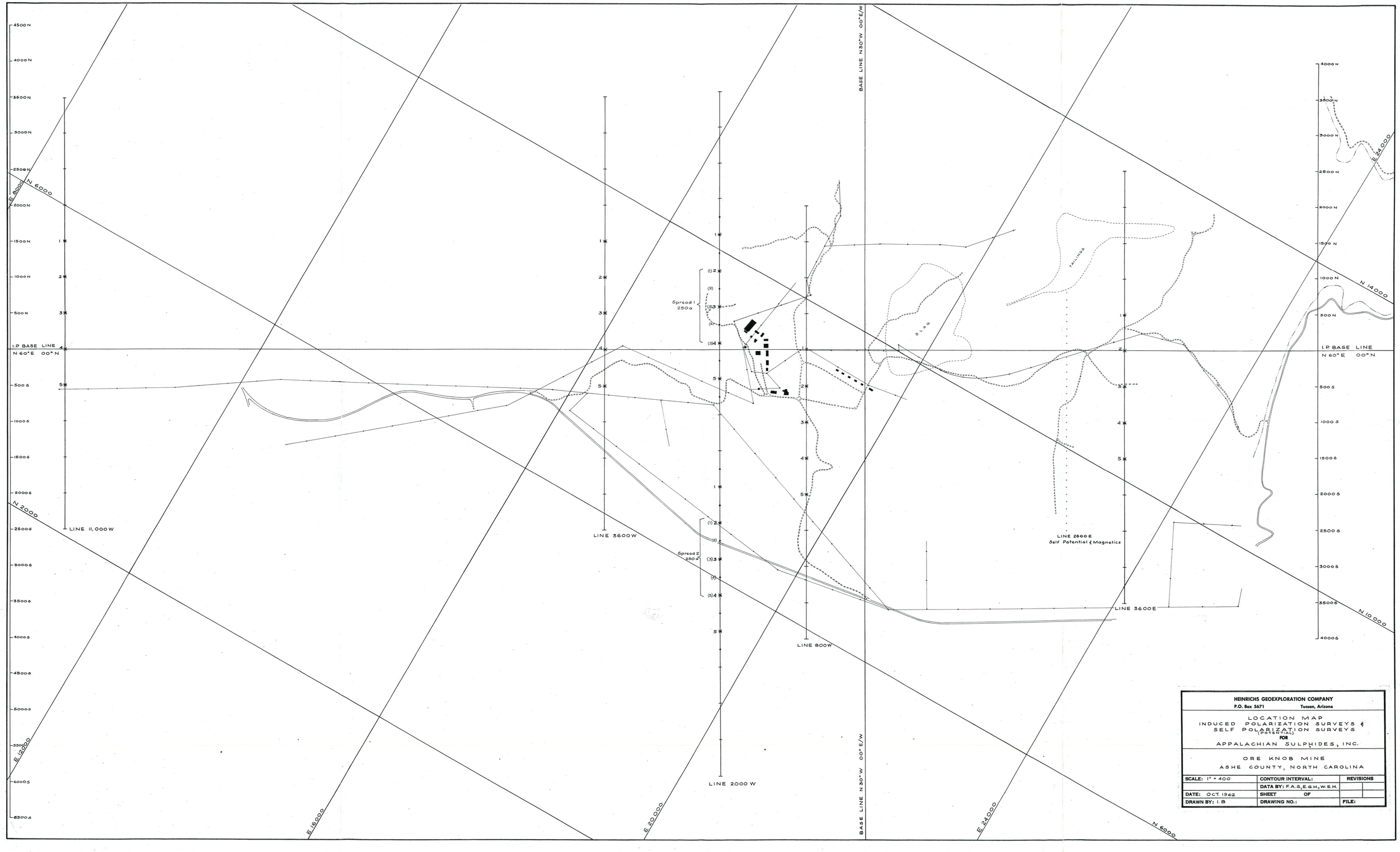
Spread 2

COMPOSITE PROFILES

LINE 2000W - Spreads 1 & 2

ORE KNOB PROJECT

October 1962 Scale 1"=400'



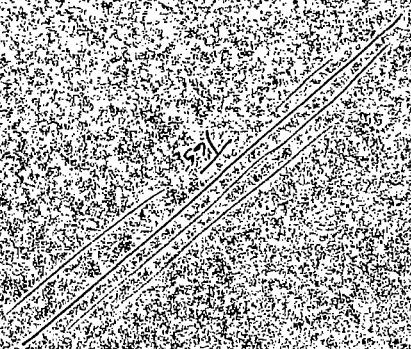
HEINRICHS GEOEXPLORATION COMPANY
P.O. Box 5671 Tucson, Arizona

LOCATION MAP
INDUCED POLARIZATION SURVEYS & SELF POLARIZATION SURVEYS (POTENTIAL)
FOR
APPALACHIAN SULPHIDES, INC.

ORE KNOB MINE
ASHE COUNTY, NORTH CAROLINA

SCALE: 1" = 400	CONTOUR INTERVAL:	REVISIONS
	DATA BY: F.A.S., E.G.H., W.E.H.	
DATE: OCT. 1962	SHEET OF	
DRAWN BY: I.B	DRAWING NO.:	FILE:

PLATE I.



SW

NE

ELEV. 3000

ELEV. 3000

2000

2000

1000

1000

Drifts caved & Stopes drawn
Ore cannot be extracted economically.

Mineable 2900 tons +30 lb cu.

Potential ore

Potential 20,000 tons of 1.5% cu.

A 60 ft. long Cross-cut into hanging wall @ Sta. 2300.

60,000 to 80,000 ton potential here; lower limit not proved. Grade in place +40 LB.

A 119 ft. cross-cut into hanging wall @ Sta. 2150.

PROBABLE EXTENSION ALONG PROJECTION OF DIKE ?

STRIKE N 61° E
AVG DIP 65° SE

POSSIBLE (HYPOTHETICAL) ORE SHOOT PARALLEL TO & IN THE SAME PLANE AS KNOWN ORE BODY.

Present plans of Appl. Sulfides do not contemplate extraction.

Drill hole - intersection in ore.

Drill hole - intersection = weak.

COPPER RANGE CO.
WHITE PINE, MICHIGAN

MAP SHOWING
PLAN & LONGITUDINAL PROJECTION OF
ORE KNOB MINE
ASHE COUNTY, NORTH CAROLINA

DRAWN: DDP	SCALE: 1" = 200'
DATE 3-22-1962	

APPALACHIAN SULPHIDES, INC.

PLAN & LONGITUDINAL PROJECTION

ORE KNOB MINE

JEFFERSON, NORTH CAROLINA

Scale 1" = 100' Date: May 1, 1962

MILL
SCALES
CORE SHACK
MILL WAREHOUSE
ELECT'C SHOP
MACHINE SHOP
WILLER SHAFT
2000 KVA SUBSTATION
HOIST & COMP. BLDG.
DRY
WARE HOUSE
ASSAY OFFICE
OFFICE
PARKING AREA
6" WATER SUPPLY LINE
6" FIRE LINE
80,000 GAL. TANKS
No. 2 SHAFT
ENGINE SHAFT
VENT RAISE
8" WATER SUPPLY LINE
PUMP HOUSE
To Jefferson
14,000 V.
E 17000
E 18000
E 19000
E 20000
N 9000
N 8000
N 10000
2500 W
2000 W
1500 W
1000 W
500 W
00
500 E
1000 E
701
841
981
982
562
702
842
S. 60° W.
N. 60° E.
Elev. 3000
No. 2 Shaft
Engine Shaft
Massive sulphides
Completely mined & crown pillars pulled
Needs timbering
$ 125,000 tons
64,675 tons @ 1.50 - 1.75%
INSERT — 1121 DRIFT

LEGEND

2.52-14.0' % copper & horizontal width of D.D.H. intersections.
Ore grade or weak intersection in Main Vein.
Ore grade or weak intersection in Hangingwall Vein.

LEGEND

Development headings, shrinkage stopings, sub-level stopings (pillar recovery). Reserves May 1, 1962 = 77,545 tons @ 1.86% Cu.
Area of probable ore as outlined by Mr. Phillip Eckman, Mine Mgr.
Area of massive sulphides
Completely mined & crown pillars pulled
Probable ore = 64,675 tons @ 1.50 - 1.75%
& 125,000 tons @ 1.25 - 1.50%

SW

NE

ELEV. 3000

ELEV. 3000

2000

2000

1000

1000

0

0

560

700

840

980

1120

PROBABLE EXTENSION ALONG PROJECTION OF RAKE ?

STRIKE N 61° E
AVG DIP 65° SE

● - Drill hole intersection in ore.

○ - Drill hole intersection - weak.

POSSIBLE (HYPOTHETICAL) ORE SHOOT PARALLEL TO ℄ IN THE SAME PLANE AS KNOWN ORE BODY.

4000N

3000N

2000N

1000N

0

1000

COPPER RANGE CO.
WHITE PINE, MICHIGAN

MAP SHOWING
PLAN & LONGITUDINAL PROJECTION OF
ORE KNOB MINE
ASHE COUNTY, NORTH CAROLINA

DRAWN: DDP	SCALE: 1" = 200'
DATE: 3-22-1962	

LEGEND

——— LIMIT OF MINERAL RIGHTS

– – – – – LIMIT OF SURFACE RIGHTS

CONTOUR INTERVAL = 20'

APPALACHIAN SULPHIDES, INC.

ORE KNOB MINE

PROPERTY PLAN

Scale 1" = 400' Date